

CCNA Part 1

Cisco Certified Network Associate

* CCNA Course Contents: (200-125)

- 1- Network Fundamentals "10 Sessions"
+ Lab (1)
- 2- Routing Technologies "5 Sessions"
+ Lab (2)
- 3- WAN Switching & NAT "3 Sessions"
+ Lab (3) + Lab (4) + Lab (5)
- 4- LAN Switching Technologies "3 Sessions"
+ Lab (6) + Lab (7) + Lab (8)
- 5- Virtualization, Security, QoS
, Network management Applications & IPv6
"5 Sessions"

*Outlines:

• Network Definition

• Network importance

• Network components

• Network topologies

• Tor2 / tawse1

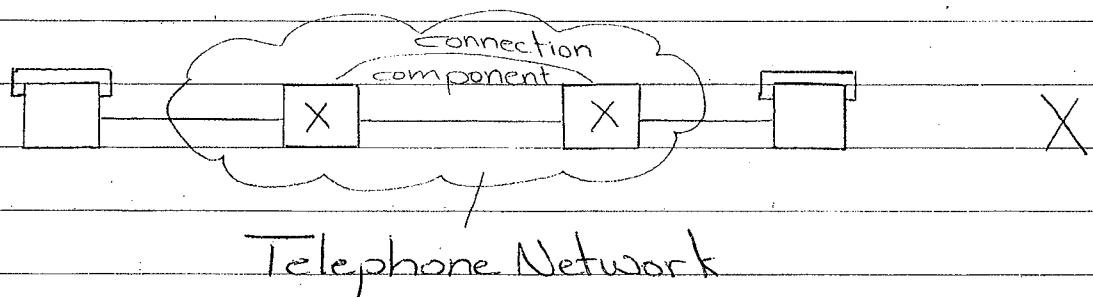
• Network types

ex: LAN or WAN

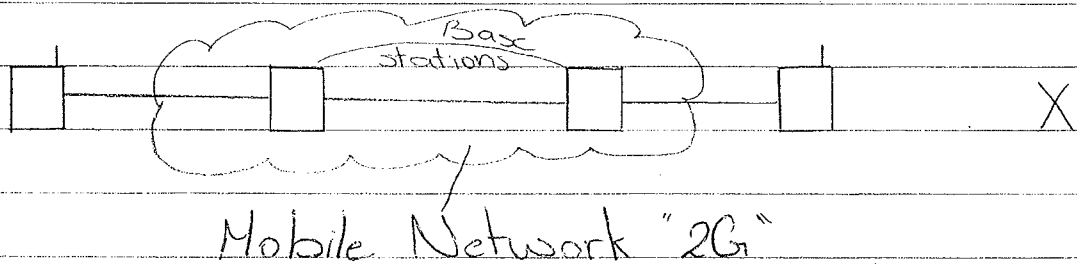
*Network "IP Network":

It is a group of components that are connected together to provide a Service.

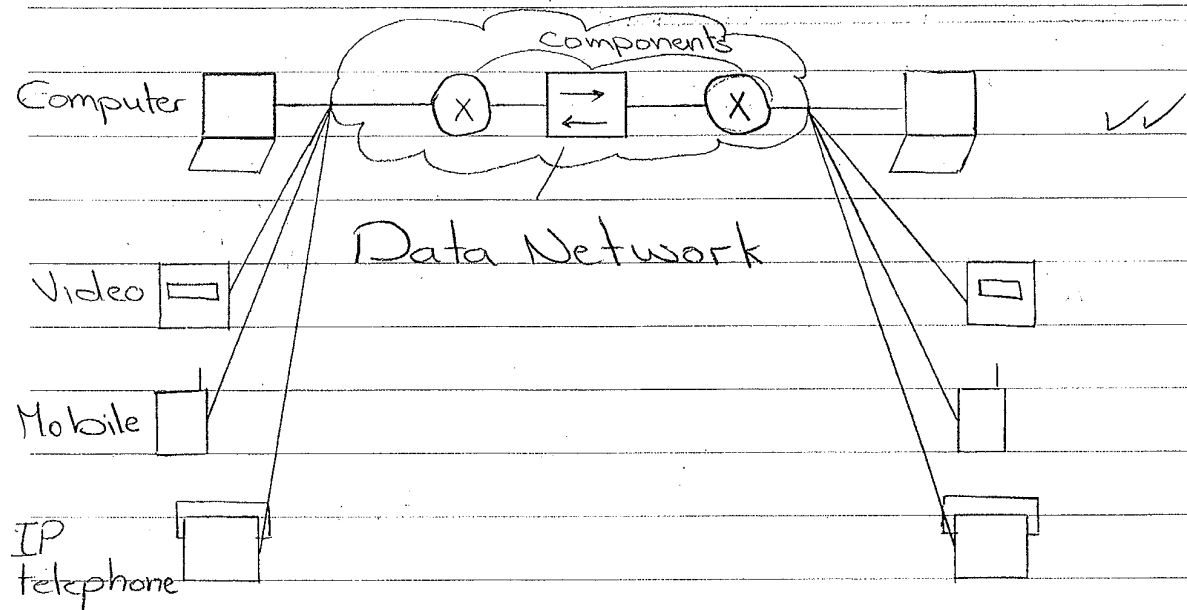
⇓
Application



Legacy Technology



Legacy Technology



Samol network leh bel "Data Network"
 3shan beten2el ma3lomat.

3'ayaro esmaha b3d kola 3shan msh beten2el
 b3 ma3lomat bkn beten2el voice w video
 w data. Fa samoha "Integrated Network"
 w b3d kola bando 3'ayaro esmaha / "IP
 Network" (IP: Internet Protocol)

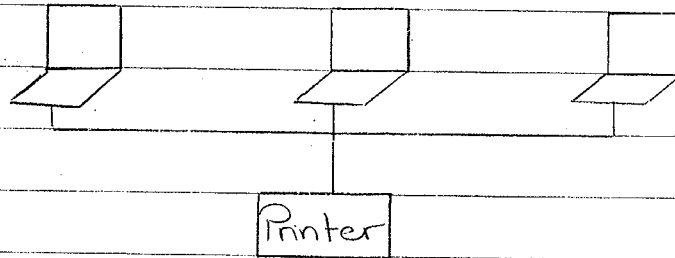
*Network importance (Application):

1- Easy sharing of data, information and files $\Rightarrow$ Data.

Betsahel Zamakiyat na2l / ma3lomat, malafat w
bayanat.

2- Easy sharing of expensive resources

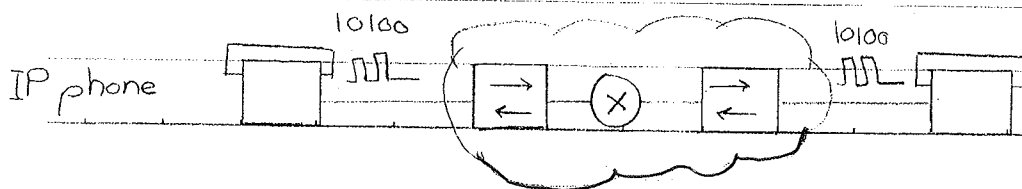
$\Downarrow$
Devices



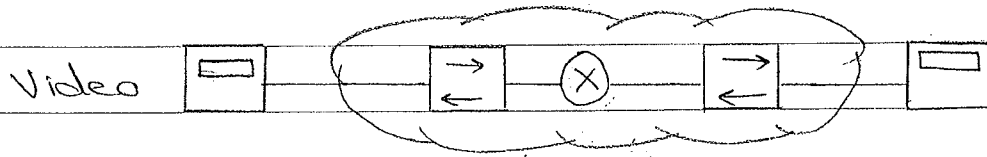
Benezmel sharing ll Devices / 3'alya 3shan
newatir fel floor 3shan law gebna / kol
ghez printer hatbza tabletta fa 3amal
network mabn / agheza.

3- Voice $\Rightarrow$ Voice.

3ayzen netawar shewaya / network fa
3amaha / Voice.



4- Video $\Rightarrow$ Video



5- Smell

6- Touch

7- Taste

All these points are called
virtual reality.

حقیقۃ افتراضیہ

*Network components "IP Network components":

1. Network devices: 80 % of Course Content

Repeater - Hub - Bridge - Switch -
Gateway - Firewall - Router -
Modem - Wireless - Access Point -
Network Interface Card (NIC) -
IDS (Intrusion Detection System) -
IPS (Intrusion Protection System).

• 1st Router: Juniper.

• 1st Switch: Cisco.

• 1st VOIP: Avaya.

• 1st Wireless: AROBA.

• 1st Price: Huawei.

2- Connectivity: 10 % of Course Content

Wired Wireless

3- Computer : 10%

It is the main component because it is the source of network applications.

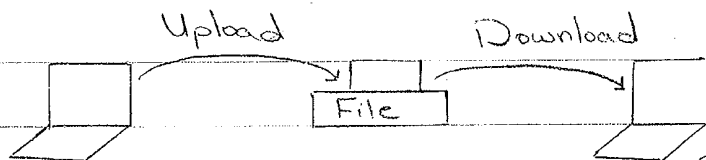
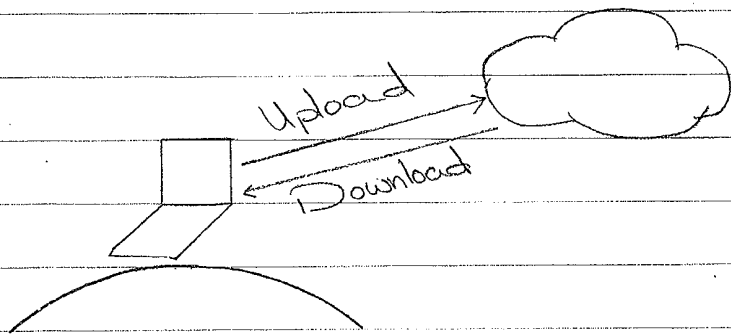
↓
services that can be done with a remote device

ex: FTP (File Transfer Protocol)

↕
Huge Files

↕
set of rules

Used For : upload & download

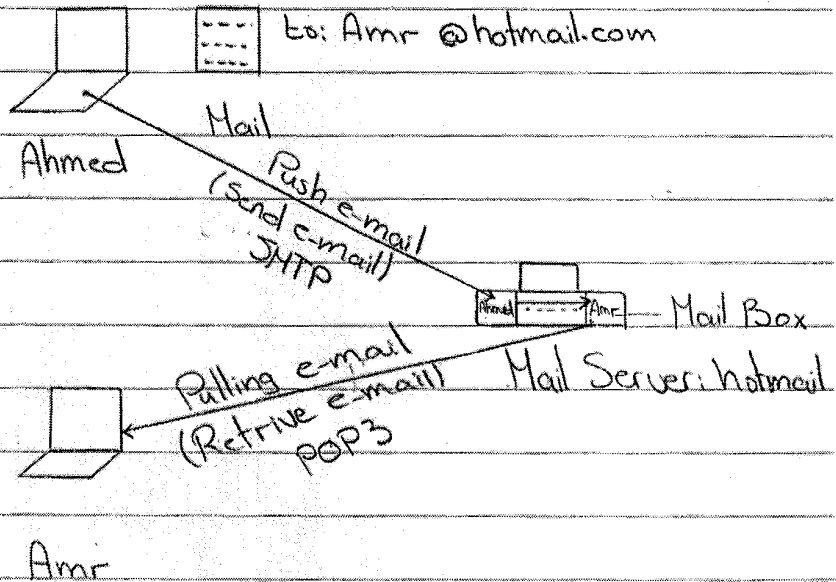


Server : 4-shared-Rapidshare

• 1 server hawa 3ybara 3n gehaz kebeer
mimkn ne5azn 3aleh 1 data 3ala tool
w neqz 1 data fe ay wazk

Bag & Drop
Exam

ex.2: SMTP & POP3
(Simple Mail Transfer Protocol)
(Post Office Protocol ver.3)



SMTP

POP3

HTTP

FTP

Telnet

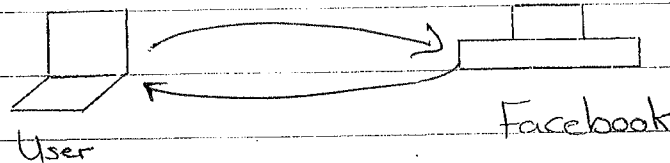


Operating System:

windows, linux, unix,
MAC OS, iOS, Android

ex. 3: HTTP (Hyper Text Transfer Protocol).

Used for browsing.



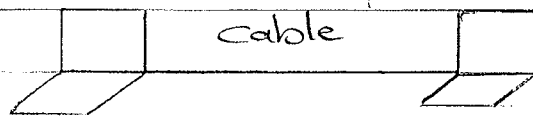
ex. 4: Telnet.

Used for remote login (configuration).

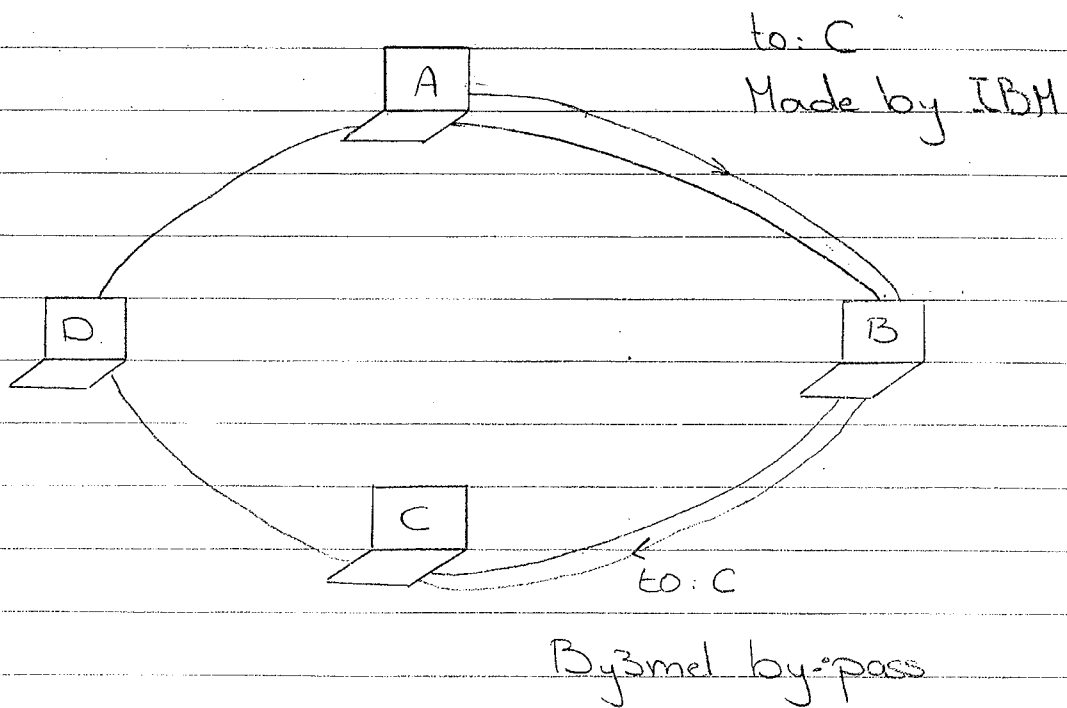
* Network topologies: طرق التوزيع

How components are connected?

1- Point-to-point:

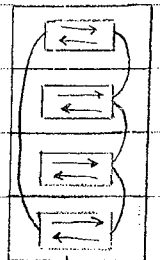


2- Ring topology:



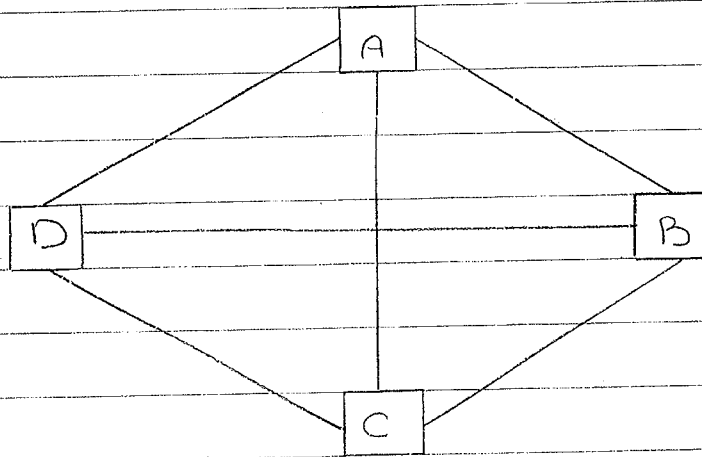
Used in Network Devices.

Dis... laf w dawaran w 3ayz cards kteer



Interview

3- Mesh topology:



Used in Network Devices

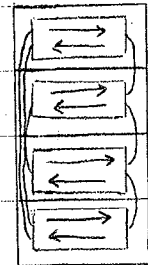
• BinaSolemba fel network devices mesh computers

• Adv: mesh la laf wala dawaran.

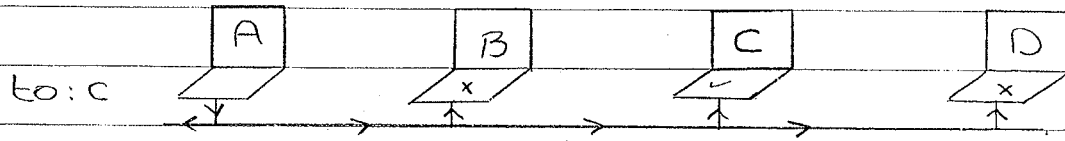
• Dis: cards akteer b-kteer.

• No. of cables = $\frac{n(n-1)}{2}$

where n is number of device.



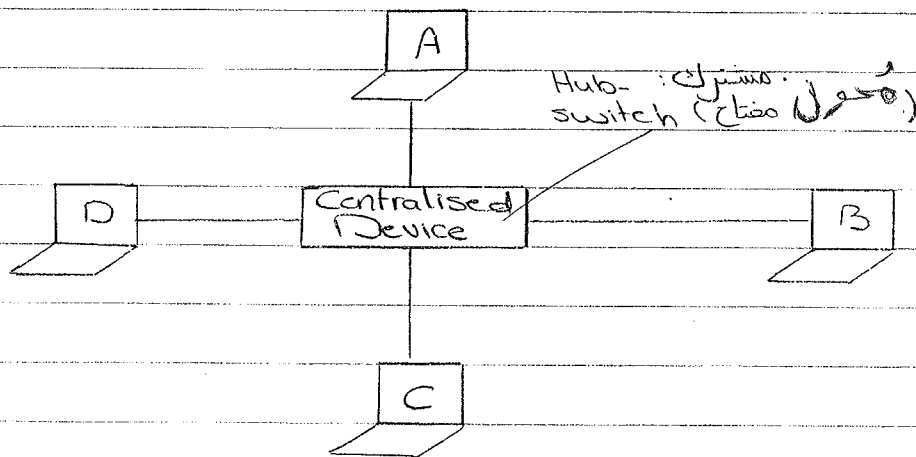
4- Bus topology:



One send, all receive.

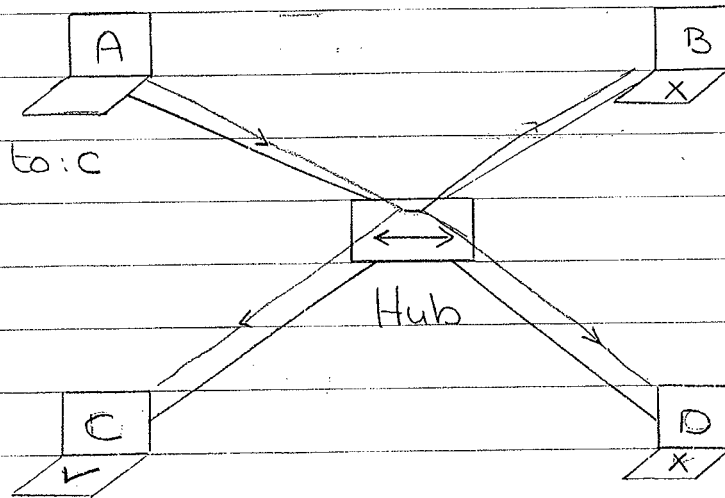
Dis.: Hereby interference or collision
تداخل الإشارات

5- Star topology:



• sherna / cables we fatena Hub or Switch

(external) (internal)
* Physical vs Logical topology:

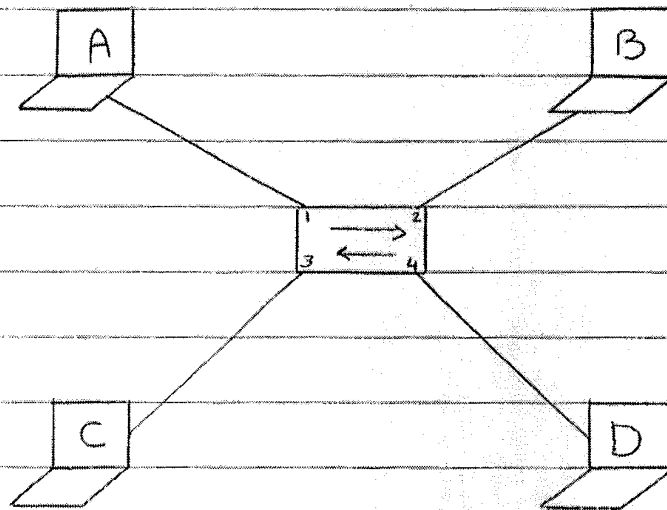


Physical topology: Star.

Logical topology: Bus.

• Hub acts as a repeater.

Here, bytsal flood (collision or interference)
 ↓
 حشو



Physical topology: Star.

Logical topology: Mesh.

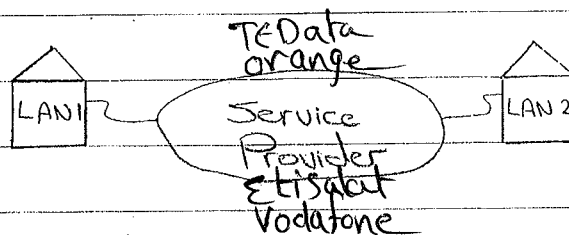
⇒ Star topology is the best physical topology

* Network types:

1. LAN: Local Area Network

It is group of components connected together to provide a service.

Under control ($\text{تحت سيطره} = \text{عقبه سيطره}$)



1 LAN hawa magmoza mn 1 components metwasalen b b3d mn 3'eer Service Provider

2. MAN: Metro Area Network.

Carple

It is groups of LANs within same city.

3. WAN: Wide Area Network.

It is groups of LANs between cities, countries & continents.

Group of LAN Connected through Service Provider

• The biggest WAN is Internet. (Public WAN)

• The second WAN is Orange. (Private WAN)

But Internet is Public WAN,
while there is another type of
WAN called Private WAN (HQ & Branches)
(Enterprise) شركة و فروعها

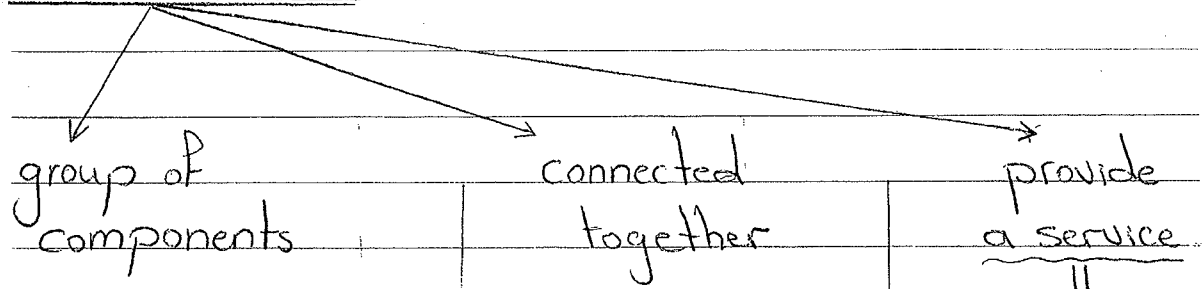
* Outlines:

• Last session review

• Network models:

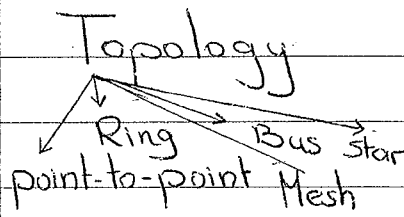
- OSI model

* IP Network :



1- End device:

computer -
IP Phone - IP Cam -
IP T.V. - Printer -
Playstation -

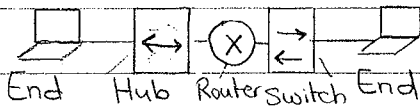


application

Data:-
browsing (HTTP) -
SMTP, POP3
Telnet - FTP

2- Intermediate device:

Switch - Router -
Hub -



Video
Voice
Smell
Taste
Touch

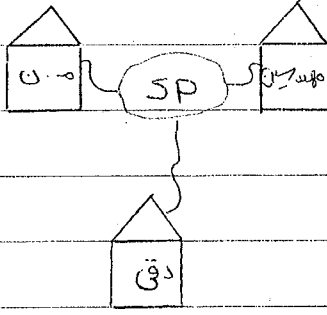
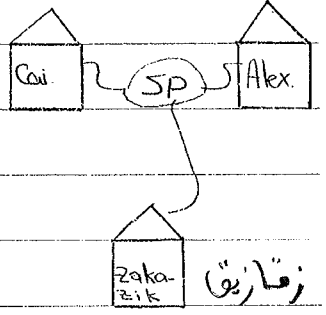
3- Connectivity:

wired (cable)
wireless
copper Fiber

Virtual Reality

Internet of things

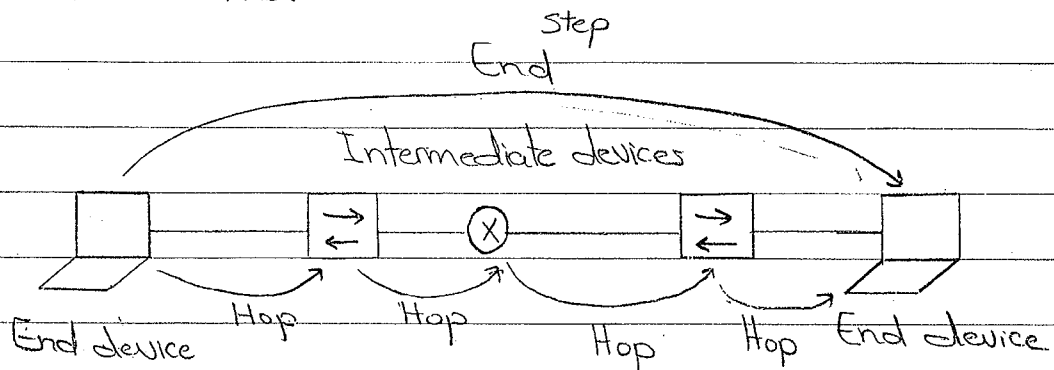
* Types of network:

LAN (Local Area Network)	MAN (Metro-Politan Area Network)	WAN (Wide Area Network)
Under control (لا يوجد تشييد) 		
Communication method: ex.1: Token Ring x ex.2: Ethernet, 10Mbps ex.3: Fast ethernet 100Mbps ← ex.4: Giga ethernet 1000Mbps ← 1 Gbps ex.5: 10 Giga ethernet 10 Gbps ← ex.6: 100 Giga ethernet 100Gbps ←	لازم يكون في نفس المدينة	Communication method: ex.1: DSL ex.2: X.25 ex.3: Frame Relay ex.4: ATM PPP HDLC MPLS

Interview

* Network model:

It is a group of concepts that will help the device to send data hop by hop & then end to end.



• OS (Operating System): End device

Windows - Linux - Unix - { + Network
MAC OS - Android - iOS } Model

• OS (Operating System): Intermediate device

IOS (Internetwork Operating System)

+ Network Model.

• 3shan 2a2dar ab3at data mabn ay gehazen
lazm ana2al 3ala 1 gehaz nafso Network
Model w el model delwa2ty byob2a Go2 2 mn
el OS.

IOS → Operating system for intermediate devices.

OSI → model device.

↓
مزد
م
OS

ex. 1: OSI Model (Open System Interconnection)

↓
Open standard
Open source

Developed by ISO.

↓
م
م

ex. 2: TCP / IP Model

DARPA → DoD (Department of
defence) model.

↓
م
م

↓ barza b3d kda

TCP / IP Model
(commercial)

• Network model is always layered.

• What is a layer?

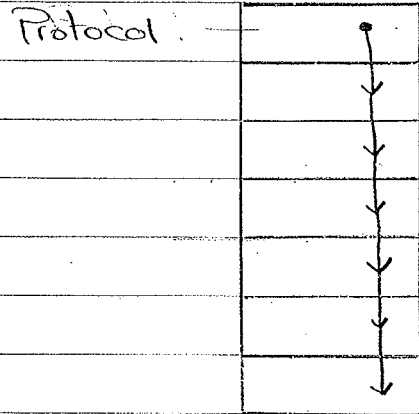
a layer is a function that can be done
either by S/W (software) or
H/W (hardware)

Model
نموذج

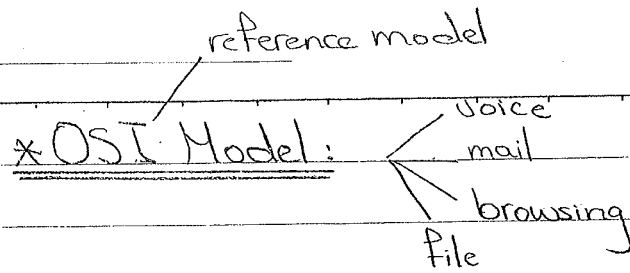
Protocol
نظام

Why layered?

these functions are sequential.



- So network model is group of functions that should be done in a certain sequence to help data reaches its final end (destination)



L7: Application	- data preparation (تجهيز)
L6: Presentation	- ترميز
L5: Session	- قائم (check list)
L4: Transport	
L3: Network	
L2: Data Link	- Network Card
L1: Physical	- Cable

• L7: Application layer:

It is responsible for making the proper data preparation for the proper service.

Service

Application

Browsing

HTTP

File upload /
download

FTP

Sending / Retriving
mail

SMTP / POP3

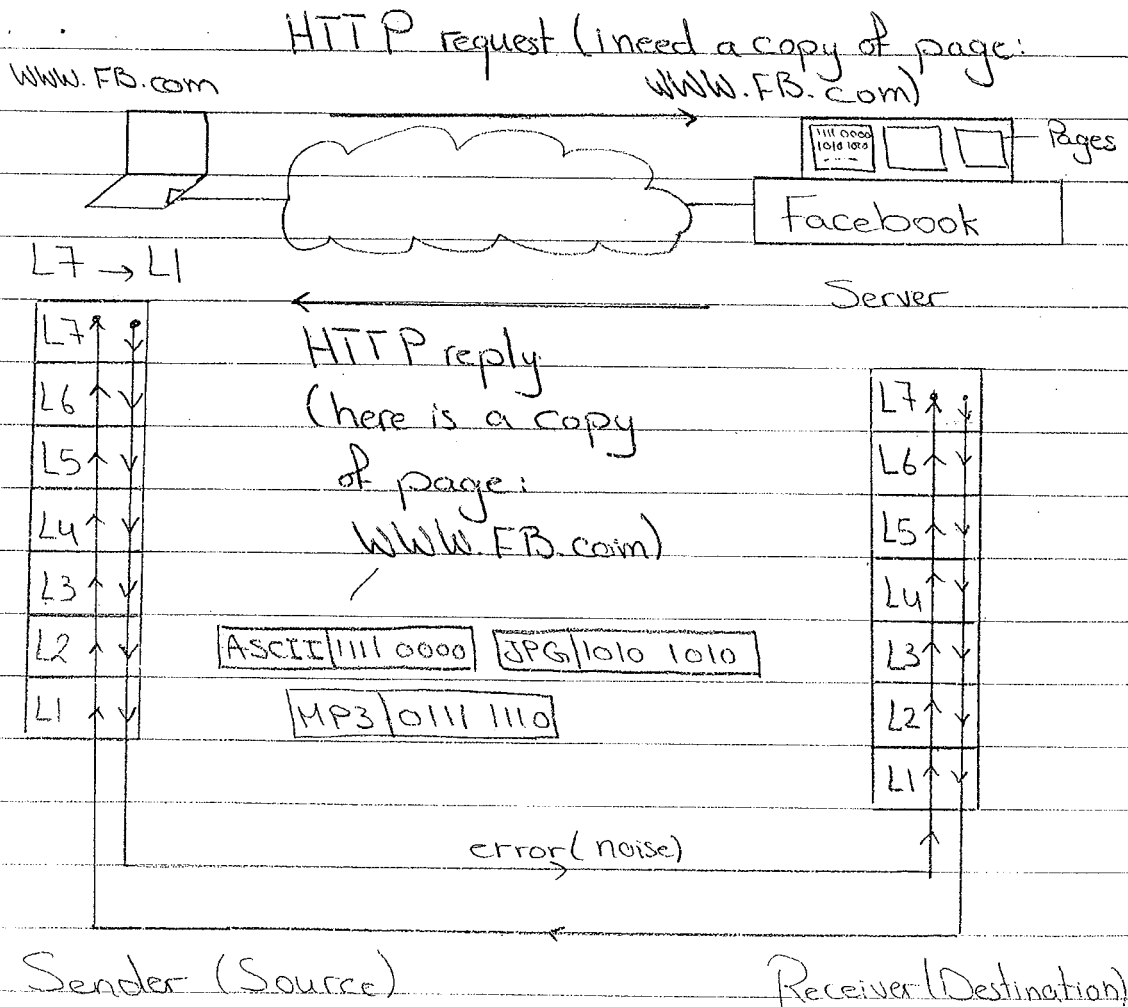
Remote login

Telnet

Voice, video,
games
(real time)

RTP

(Real time Transport
Protocol)



Sizat: Bytsal error lama L data tetta3 mn l
cables, bs mafeesh error been el layers n/saha

server howa 3obara 3n gehaz computer
3aleh 5/W. by 5alem 1 2a5reen (الفرجين)

• L6: Presentation layer:

It is responsible for finding data representation between sender & receiver.

ex.2: ASCII → Text.

• kol 8-bits b Farf, w dah door 1 presentation layer.

ex.2: JPG, GIF, TIF, → Picture.

ex.3: MP3, midi, → Audio.

ex.4: Avi, mpeg, → Video.

• L5: Session layer:

It is responsible for making sure that all information required for session opening become ready & in that case it will give orders for:

- session establishment. شروع
- session management. نظم و کنترل
- session termination. ختم

to: amr@hotmail.com

mail
box

post
office

cc:

Bcc:

Subject:

Mail Body

attachment: file

send

check list

✓ to
✓ syntax of to
✓ attachment

• 1 session layer b-check 3ala mokaawenat
1 mail 7 ay (sender adress, ...)

• betedy tafwed II transport layer
enaha te7l mashakat I data lama
to 5roq bara I gehaz

• L4: Transport layer:

It is responsible for actual mechanics of:

- session establishment
- session termination
- session management & control

S/W

Handshaking

data

ex.1: TCP (Transmission Control Protocol).

ex.2: UDP (User Datagram Protocol).

* Outlines: *

· Review on last session.

· TCP / IP model.

· Typical network model & components.

Interviews

* OSI model:

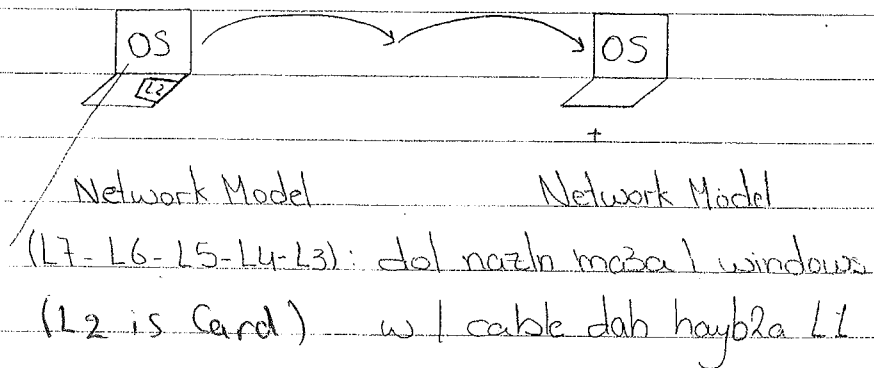
browsing
mail
file
video-voice-
game

kol dah 1 data gowa 1 computer	L7: Application	تطبيق
	L6: Presentation	تقديم (bataweb / one's w zeros)
	L5: Session	جلسة (check list)
	L4: Transport	
	L3: Network	
	L2: Data Link	Network card (bashof ports bs)
	L1: Physical	Cable (bara / gehaz)

3shan 2a2dar afkr tarteb 1 layers:

All People Seems To Need Dominos Pizza

la'zim kol gehaz yenzal 3aleh network model 3shan
ye2dar yetham ay gehaz tany:



Presentation layer betktb garb kol 8-bit deh
3obara 3n ah text, picture, audio, ...

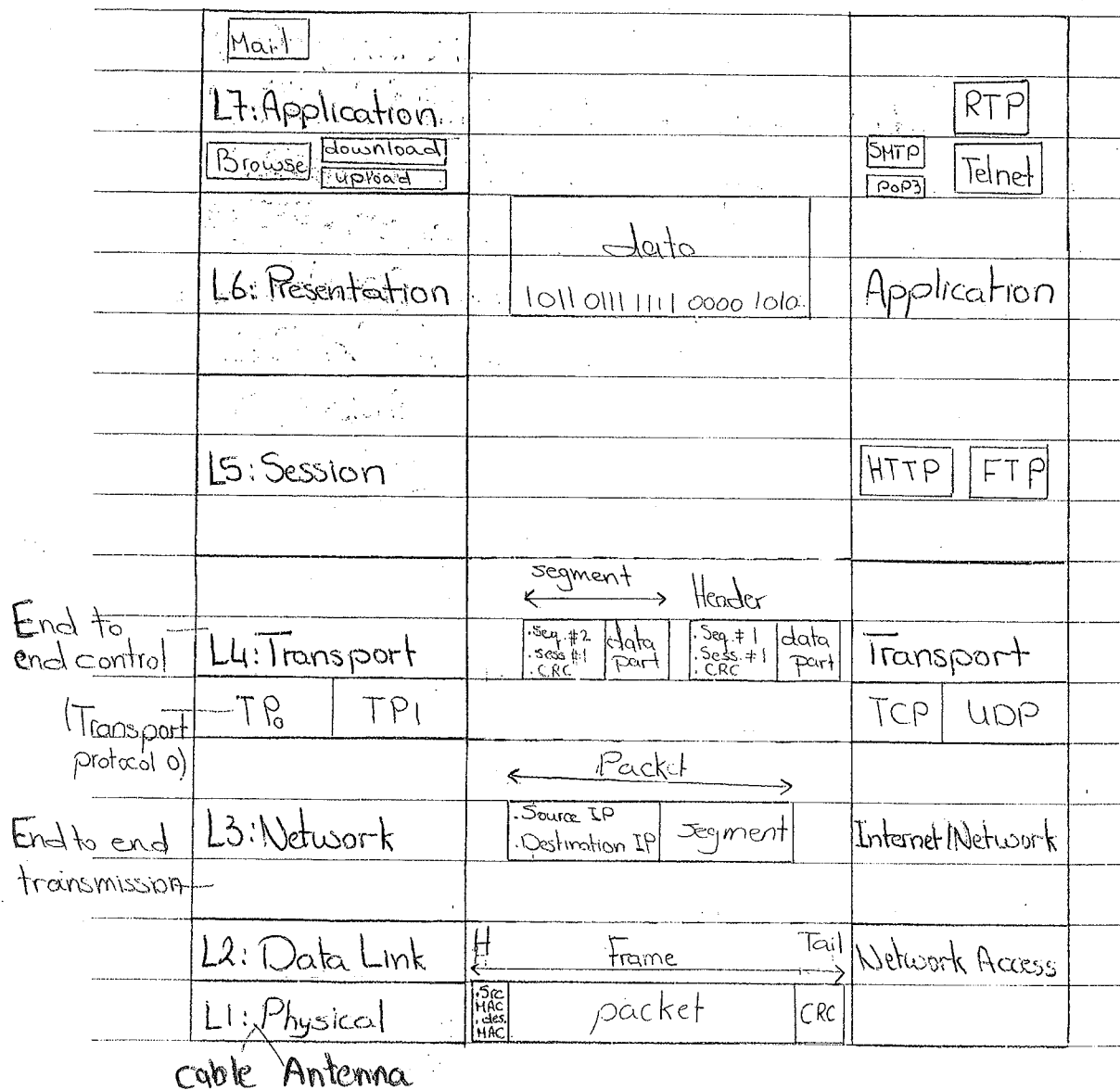
• Session layer b-check / list beta3etha betshot.

to: ---, mail box, server mail, / size beta3
/ attachment, ---.

• Applications are: FTP, HTTP, Telnet, SMTP, POP3.

• / 4G beyshta3al bel Voice / IP.

* TCP/IP model: ← browsing
mail
voice file



OSI Model

TCP/IP Model

• Pel OSI Model kol layer w kha rakm lkn Pel TCP/IP Model 13aks kol layer malhash rakm heya leha esm bs

OSI

TCP/IP

Unit

L7, L6, L5



Application

Data

Application layer fel TCP/IP betlam be nats
1 Functions elly fe L7, L6, L5 elly fel OSI model.

Application layer (HTTP - POP3 - SMTP - FTP - Telnet)
elly fel TCP/IP bet-gaher w bet-code w
bet-check.

1 data elly fel Application layer elly fel TCP/IP
heya 3obera 3n zero's w one's, w 1 data
deh betmasel (taste - touch - smell - ...)

Exam

Which of the following are applications: choose two
ping - Telnet - TCP/IP - FTP - ICMP
1 bazy shol protocols msh applications

1 applications fel TCP/IP mostakken 3n
elly fel OSI:

OSI

TCP/IP

Browse

HTTP

Mail

SMTP & POP3

Download & Upload

FTP

maknsh feeh

RTP fel OSI

RTP

L4 $\longleftrightarrow$ Transport Segment
(data part + Header)

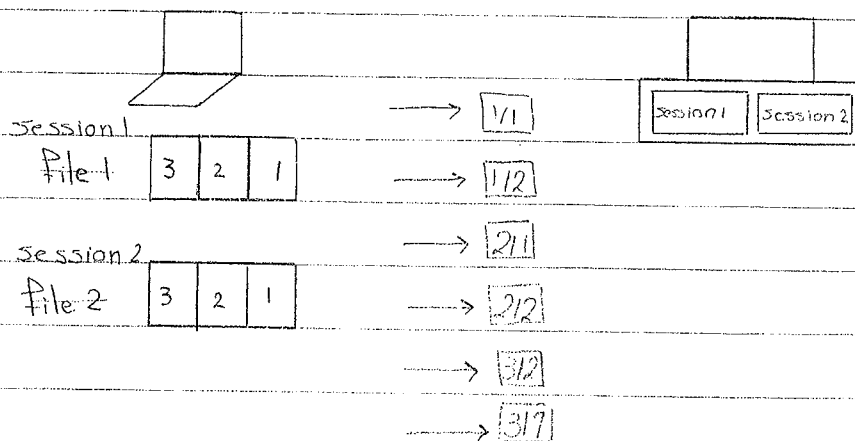
Interview • door 1 Transport layer for TCP/IP:

Session management { • Segmentation
• Sequencing & addressing
• error detection using CRC (Cyclic Redundancy control) check }

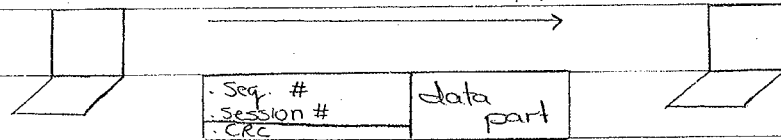
Transport layer befasem 1 data 1 parts
3shan law fe error fe bit aw etnen
Pa matrag 3sh 3ala kob 1 data 1 kbera

• Segment size $\approx$ 1500 byte

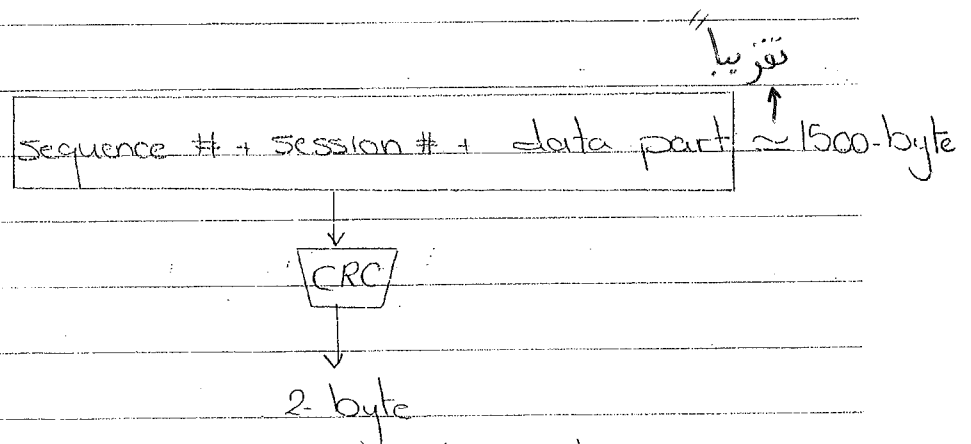
$\Downarrow$
8-bit



7atena session number 3shan 2a2dar a3rap
en anhy data betazt anhy session.



1 CRC howai howa 3obara 3n masba
 masabara mn 1 data (bysaiwar 1 data)
 3shan a3raf iza Kan error. Byggarn mbn
 1 data part w sequence number w
 session number w mbn 1 CRC 3shan
 2a3raf iza Kan feeh error walla mafeesh



1 CRC byd3at 1 data part w sequence #
 w session # 1 2-byte

Exam

Which layer is responsible for segmentation,
 sequencing, error detection in OSI model:

L1 - L2 - L3 - L4 - L5

L3 ← Internet / Network → Packet
(Network) (data part + H + H)

• 1 IP dah 30 bara 30 raqm 1 end device

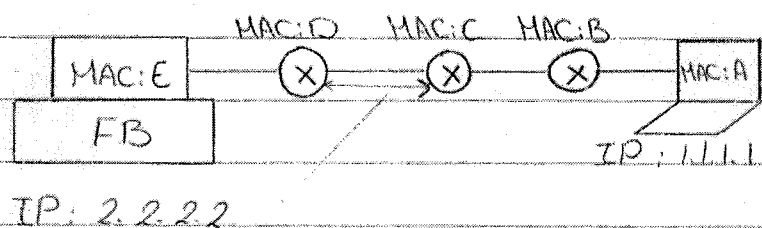
• IP address: final end address.

L2, L1 ← Network Access → Frame
(data part + H + H + H + T)

• door 1 card w cables in OSI: hop-to-hop transmission & control

• MAC address: hop to hop address.

• lazm kol gehaz yeb2a lekh MAC.

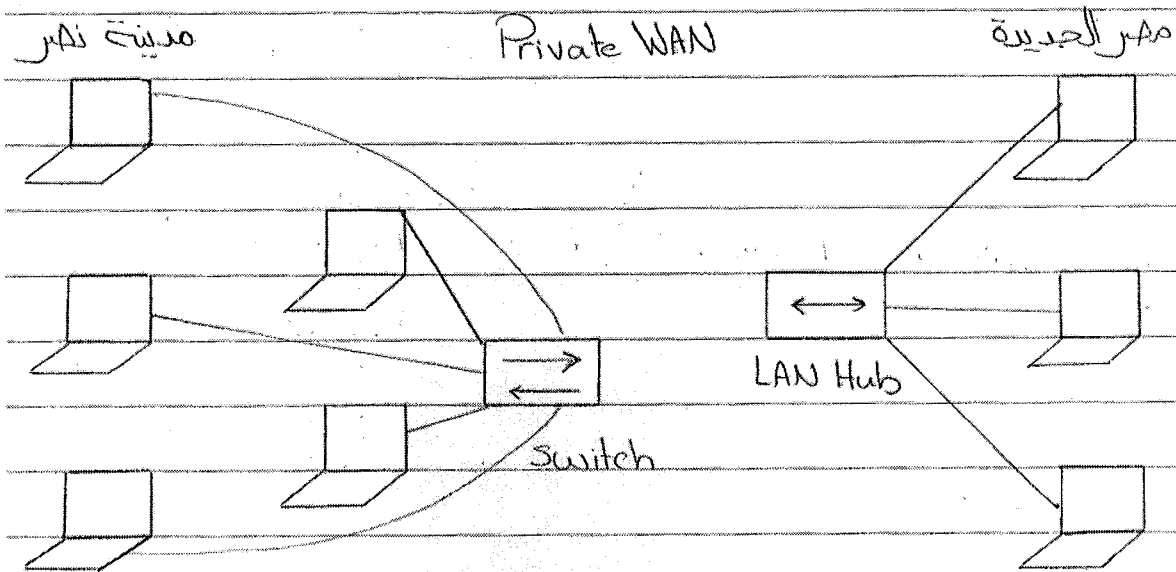


Src MAC: A	Src IP: 1.1.1.1	Seq. #	data part	CRC
des. MAC: B	des. IP: 2.2.2.2	Seq. # CRC		

Src MAC: C	des. MAC: D	data part	CRC
------------	-------------	-----------	-----

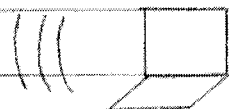
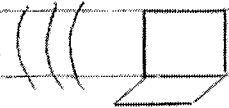
hena kol shewaya / tail w head byt'ayaro
3shan 1 Frame byro7 mn device 1 tany.

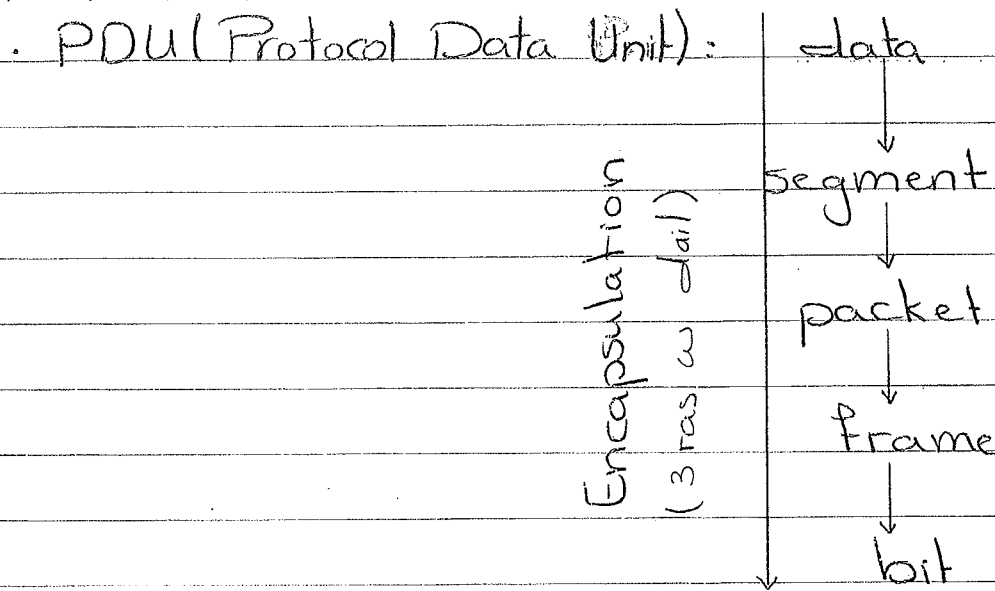
* Typical network model & components:



3ayen n3ml network
mabn 3 fero3 mawgodh
fe amakni mostalefa. w
deh tosama bel
private WAN.

قوة





Finally:

L3 = Packet = IP address = final end

L2 = frame = Mac address = next hop

1- End device:

It is the source of applications. It is layer 7 (Application).

• elly yet hm layer, haythm ay layers ta tteha.

2- Hub:

It is used as a centralised device to provide physical star topology. It doesn't know neither final end ^(No IP) nor next hop ^(No MAC). It floods bits. It is layer 1 device.

• Final end = layer 3 → Packet → IP address

• Next hop = layer 2 → Frame → MAC address.

• 1 Hub 3am/ zay 1 cable.

↓ layer 1

3- Switch & Wireless Switch: (Wireless Access Point)

It is a centralised device to provide physical star topology. It doesn't know final end but it understands next hop. It is layer 2 (Network Access Layer).
 ↓↓
 (MAC, Frame, layer 2)

• 1 par 2 mbn 1 hub w switch:

Hub: layer 1, la by phm MAC wala IP

Switch: layer 2, by phm MAC.

Switch Dis:

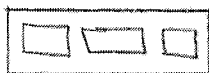
All its port support by H/W
 Single Communication Technology.

LAN

• Ethernet.

• WiFi.

Ethernet Switch



LAN

Frame Relay Switch



WAN

• DSL

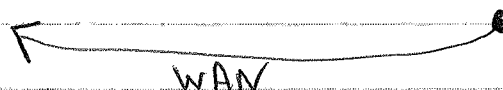
(Digital Subscriber Line)

• X.25.

• ATM.

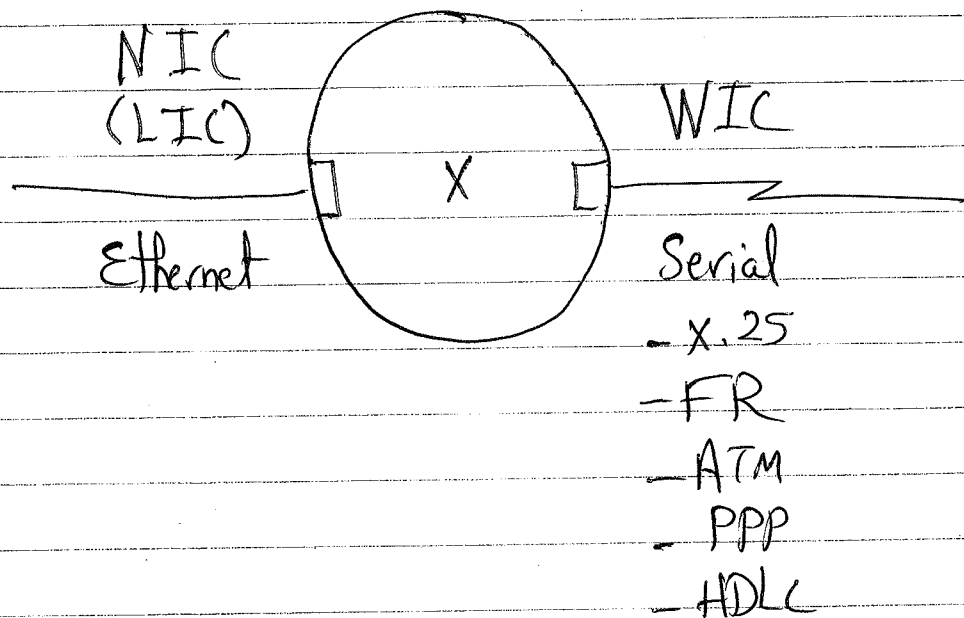
• Frame Relay.

• ISDN



4- Router:

Mixed technology. It understands final end.
It is layer 3



NIC: Network Interface Card

LIC: LAN Interface Card

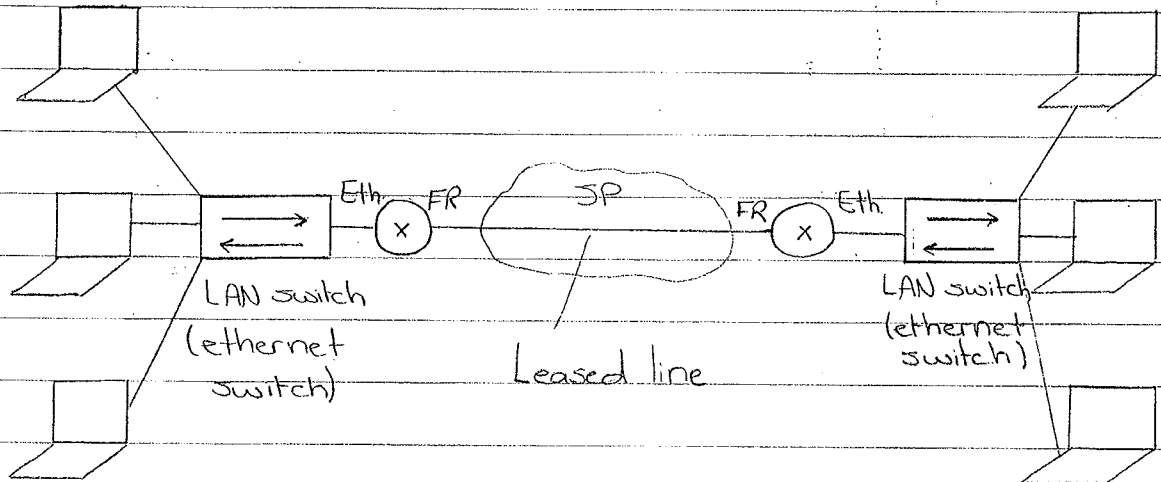
WIC: WAN Interface Card

*Outlines:

· Last session review (components & model)

· Physical layer

* Typical network model & components:



• Berastandem Frame Relay in Private WAN.

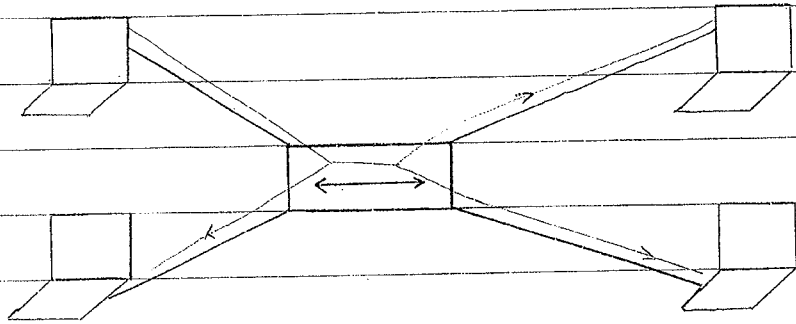
• law Sandy farzen w. Sayra awast mbinham f. berastandem leased line la'na 2ar 5as 1 component w. dah 3abara 3n selk mastan ta'at 1 ard.

• In reality mynt3sh 2astandem 1 leased line 1 asbab seyaseya w. edareya fa berastandem ba'ala WAN switch:

• Seyaseya: law astandem leased line ana msh ha'2dr arab ay 7ad by3mel 7aga 3'alat f. 3shan kola msh mastandem.

• edareya: law fe mosharek madaf3sh 1 eshtarak 1 shahryawl sanawy 1 service provider msh hay2dar yetab3 3aleh 1 net fa 3shan kda bnastandem WAN switch 3shan law madaf3sh 1 SP yetab3 3aleh 1 eshtarak

1. Hub:



- שחזור כל LAN בו.

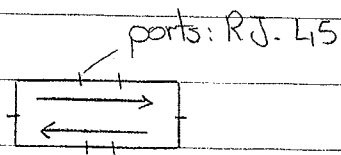
- בייטאםל ממשל bit-by-bit.

- בייטאםל data לכל ports, כל בייטאםל Flooding.

Flooding: sending data out of all ports except receiving port.

- LAN only
- Layer 1
- Low cost
- Very fast

2. Switch:



LAN switch
(Ethernet switch)

- Card inserted in it is NIC (Network Interface Card)

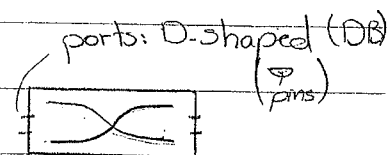
- 1 NIC sha3'al bel ethernet

- Low cost.

- High speed.

- Speed ↑ 3shan math modulation

- Short distance.



WAN switch
(DSL switch-

X.25 switch-

Frame Relay switch-

ATM switch-

ISDN switch-

- Card inserted in it is WIC (WAN Interface Card)

- 1 WIC sha3'al bel frame relay

- Long distance

- High cost.

- Lower speed.

By H/W Single Communication Technology.

Layer 2 (hop, Frame, MAC).

More cost than Hub

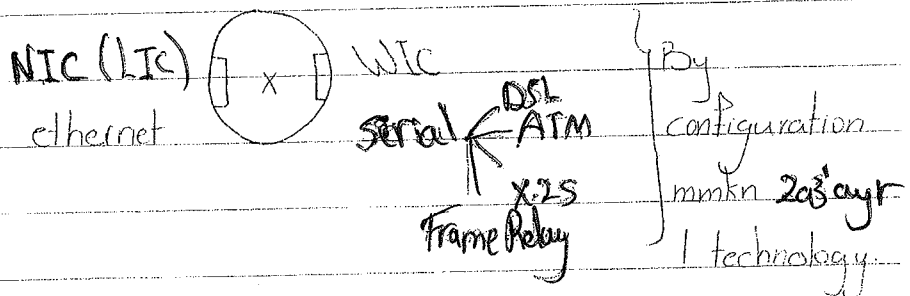
3- Router:

Support different technology (high cost).

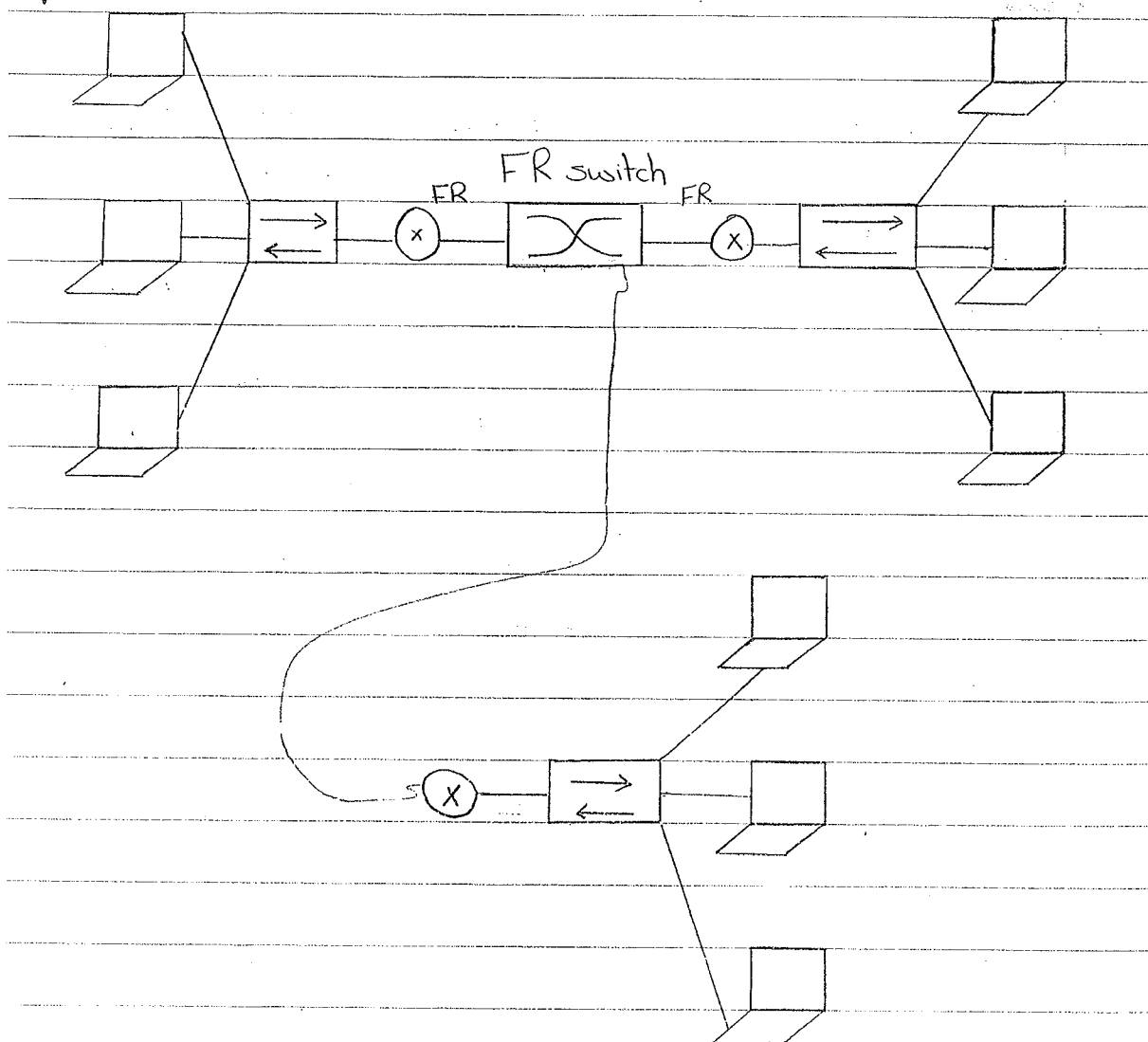
By S/W (slow).

3shan 2a3'ayar 1 technology lazim yete2a feeh
programming fa kala bate2

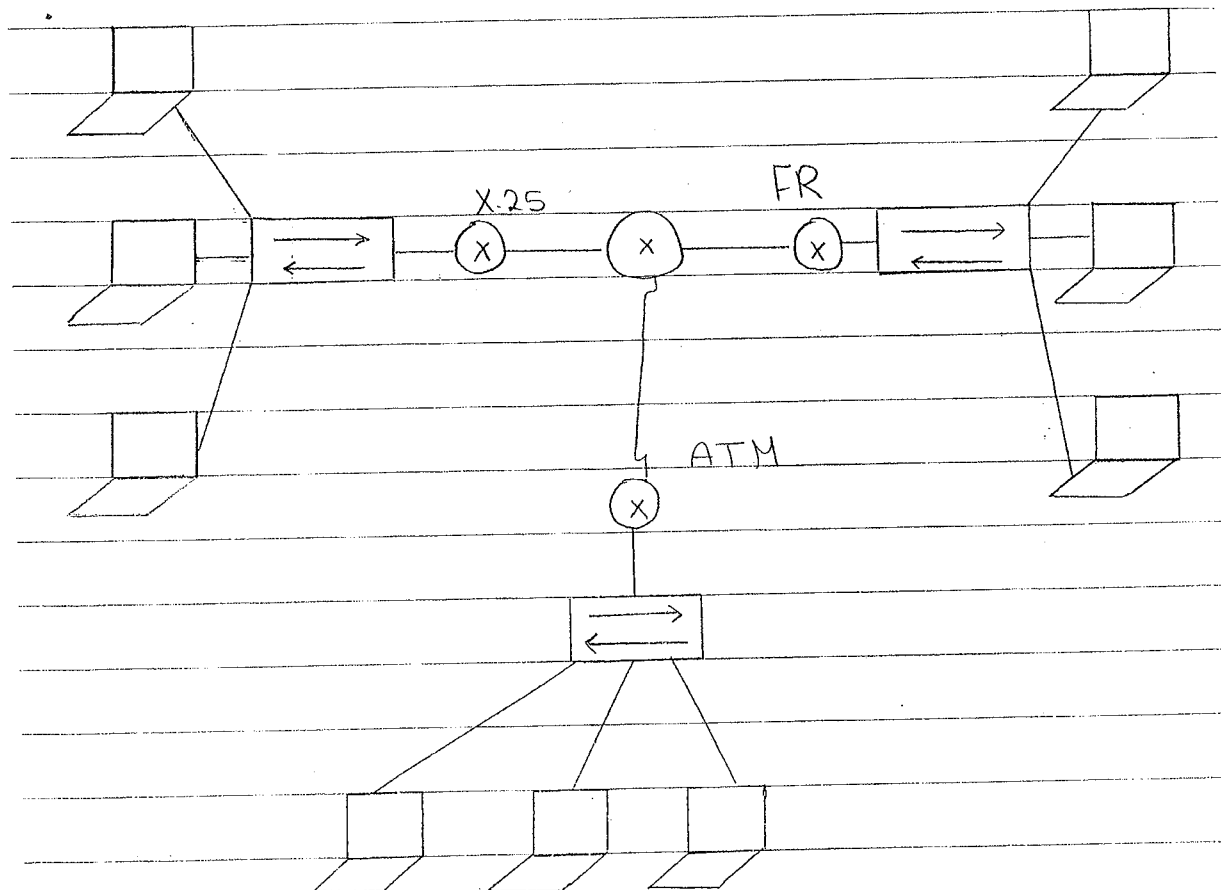
Layer 3



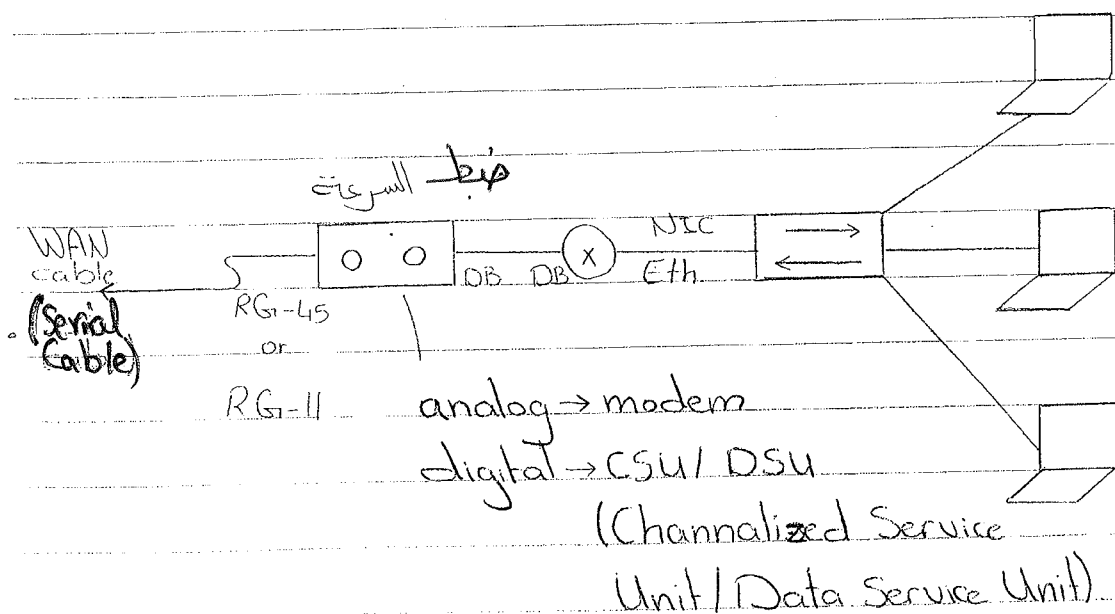
1 WIC betazet 1 router mo5tallefa 3n 1 WIC
betazet 1 switch



law 3ndy aktr mn far3een w 3ayta awasl horn
b b3al Hast5dm WAN switch.



4-



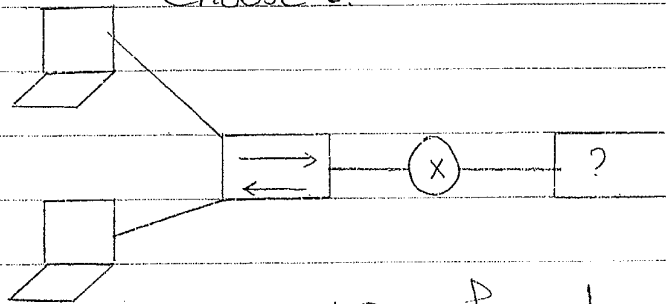
- 1 router daymn ahwag w sare3 w 3ayez ye 5 las mn
1 data besor3a 3shan 1 SP mctaded be sor3a
mo3ayyana fa hantot modem 3shan yezabt
sor3et 1 router fe bot 1 data.

Modem is used for clocking & synchronization. (نقطة السند)

Modem is layer 1.

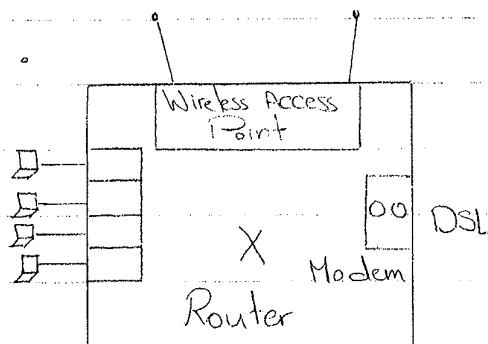
Exam

Choose 2:



- x a- CSU/DSU if analog
- ✓ b- CSU/DSU if digital
- ✓ c- modem if analog
- x d- modem if digital

• dah shakl 1 router elly fel beet:



All devices are classified:

DTE

(Data Terminal
Equipment)

(3rd
level)

DCE

(Data Communication
Equipment)

It is a device that can either be source or destination for data ^{data} ^{browsing, mailing} information. It is at least layer 3.

ex: End Device, Router.

It is a device that can either be:

supporting star topology.
or
supporting clocking & synchronization:
It is layer 2 or layer 1.

ex: Hub, Switch,
Wireless Access
Point, modem
CSU/DSU

* 1.1: Physical layer:

• PDU (Protocol Data Unit): "bit".

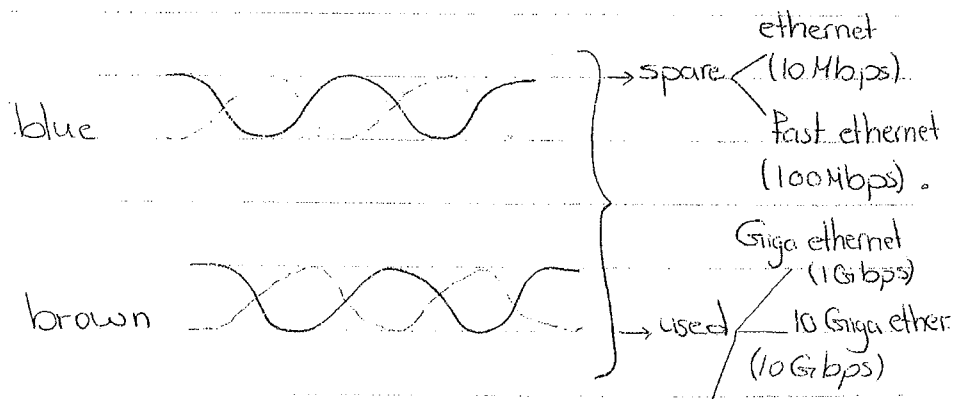
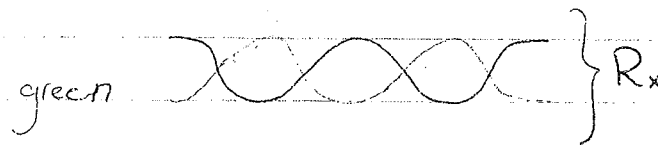
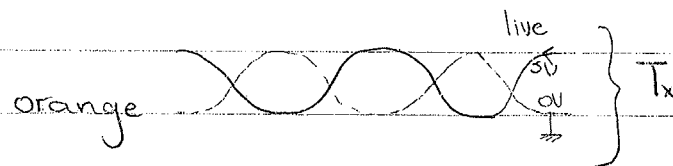
• LAN Physical layer

Cables Standards Connectors Devices

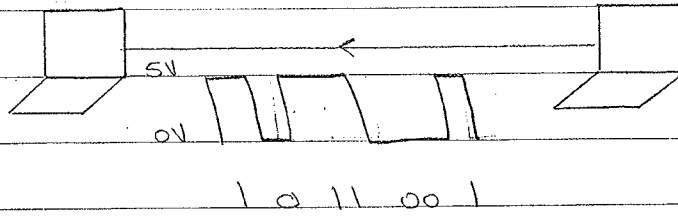
1- LAN Cables: Ethernet Cables.

a- UTP: Unshielded Twisted Pair (100m)

8wires → 4wires



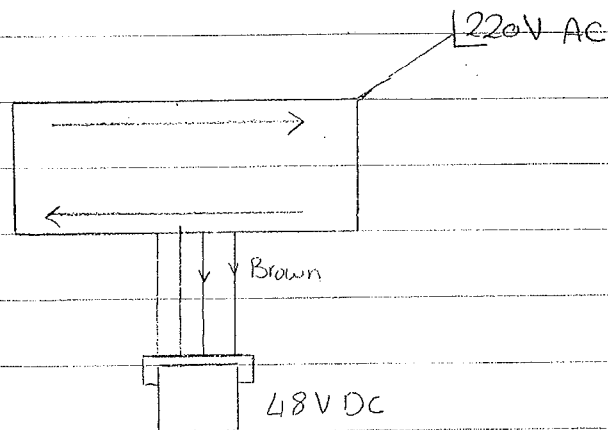
POE
(Power Over Ethernet)



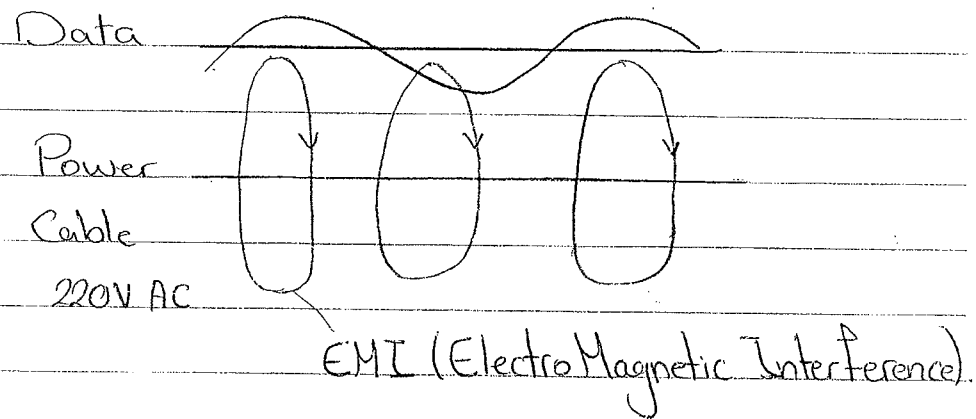
1 cable msh byfham la one's wala zero's byfham
bs volt

Redundancy: one is none.
وڤور بيل two yadbbak one

POE switch: dah switch fceh adaptor
3shan basll mawast 1 phone
bel qahraba we selko yezaks 1
data fa hawast 1 phone bel
switch 3aila tool w yeb2a kda
fceh power waslala.

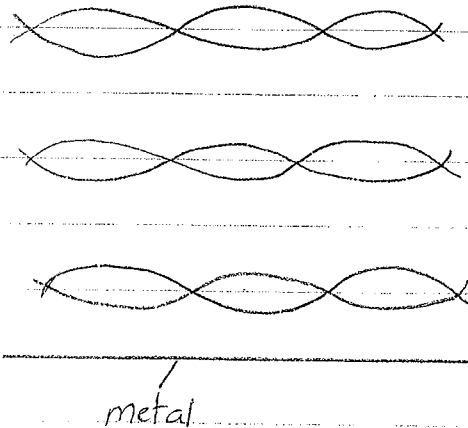


Dis: Noise



Solution: ① distance between them 60cm
② STP

b- STP: Shielded Twisted Pair.



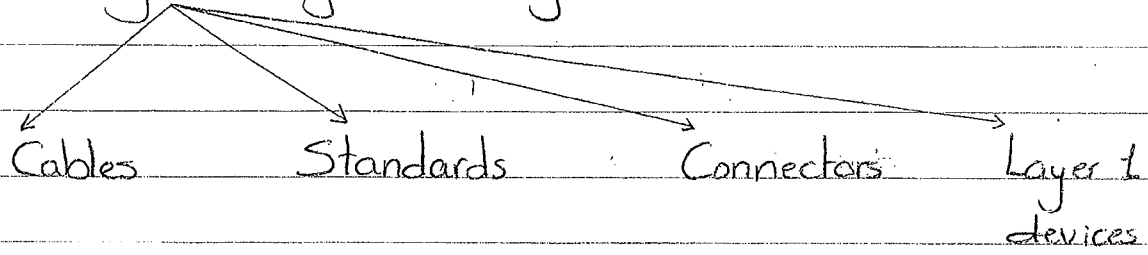
C-Fiber:

- Faster: 100 Gbps

- Longer: 100 km

- Immune against EMI & RFI (Radio Frequency Interference)

* Physical layer: Layer 1 (in LAN)



1. LAN Cables: Ethernet Cables.

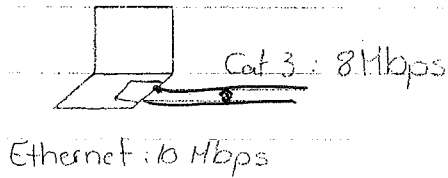
- a- UTP : Unshielded Twisted Pair.
- b- STP : Shielded Twisted Pair.

} Copper
cable $\rightarrow$ 10Gbps
 $\rightarrow$ 100m

- Twisted Pair Categories:

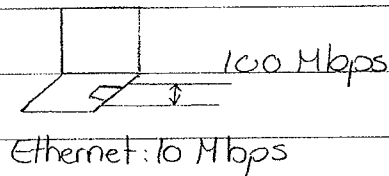
Cat 3 (not in LAN) $\rightarrow$ 8Mbps

- bystasdam fel DSL (cables madPona taft
1 ard mlon 1 beyot w / central).



✓ Cat 5 → 100 Mbps (100m)

· msh benst 5 dm 1 ethernet 2 aktr mo 100 m
due to attenuation.



✓ Cat 5e → 1000 Mbps (1 Gbps) (100m)
↓
enhanced

Cat 6 → 4 Gbps (100m) x

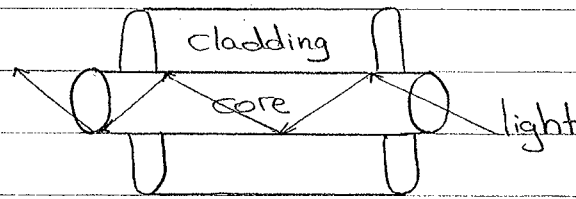
· msh cards sha'al b 4 Gbps

Cat 6A → 10 Gbps (100m)

✓ Cat 6E → 10 Gbps (100m)

Cat 7 → 40 Gbps (100m) x

c- Fiber:



- law 1 signal 1 haydy do 2.
- Law 0 yob2a mafesh do 2.

Fiber Categories:

MMF (Multi-Mode Fiber)	SMF (Single Mode Fiber)
• Cladding diameter = 125 μm	• Cladding diameter = 125 μm
• Core diameter = 62.5 μm , 50 μm	• Core diameter = 9 μm , 8 μm
• Distance = 400m, 4km	• Distance = 10 km, 100km
• Speeds = 100 Gbps	• Speeds = 100 Gbps

- 1 Far2 malon 1 fiber w copper:

مسافات أكبر

سرعات أكبر

Immune against EMI & RFI

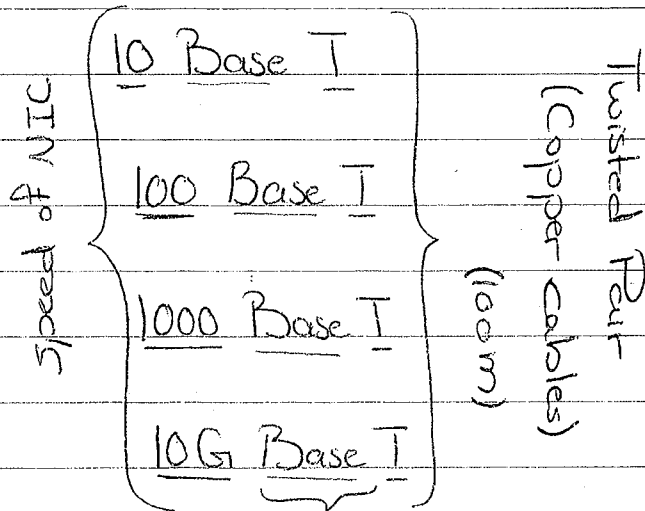
القياس

2. LAN Standards 1980 Feb.

IEEE 802.3 = Ethernet

1980 Feb.

Types of NICs:



Base band = no modulation.

= no need for modem.

10 Base F

100 Base F

1000 Base-SX } (short distance)

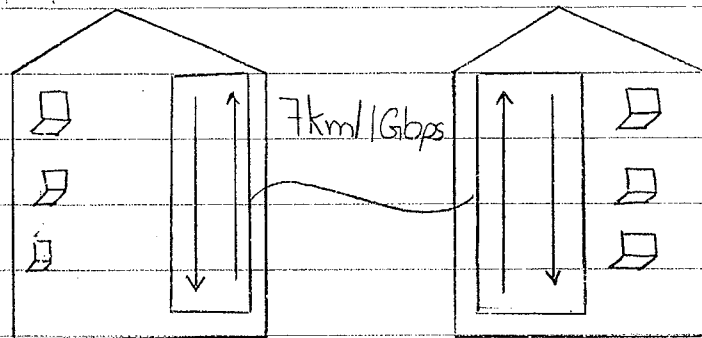
10G Base-SX } → MMF 62.5/125 (400m)

100G Base-SX } → MMF 50/125 (24 km)

1000 Base-LX (long distance)
10G Base-LX SMF 9/125 (10km)
100G Base-LX

1000 Base-ZX (extra long distance)
10G Base-ZX SMF 8/125 (100km)
100G Base-ZX

Exam



distance ↑ NIC type? 1000 Base-LX
speed ↓ Cable type? SMF 9/125

3. LAN Connectors: Ethernet Connectors

• Fiber Connectors:

ST = Straight Tip.

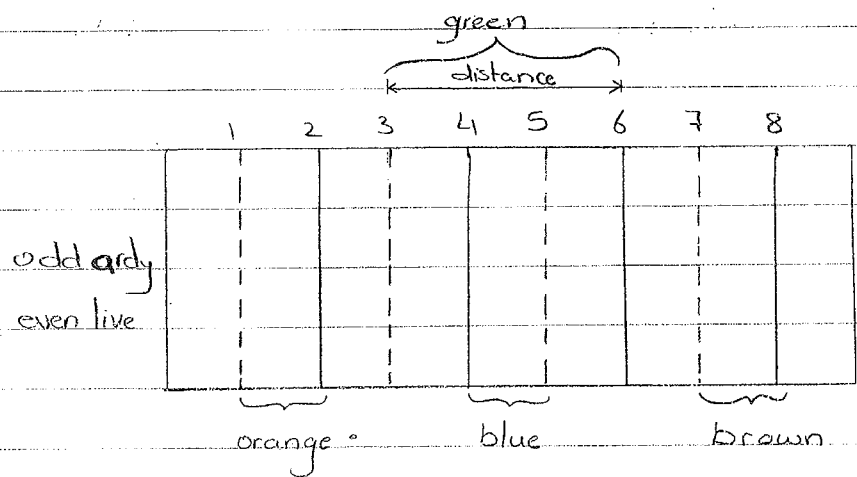
SC = Square Connector.

• Copper Connectors:

DB = D-Shaped.

 (in WAN only)

RJ = Register Jack
RJ-45



hasaly l sensor fe wshy

Tx pin 1,2

فوانج

Rx pin 3,6

فوانج

• Colour Coding Standard:

Pin 1, 2	Orange	} Standard T568B (Standard B)
Pin 3, 6	Green	

Pin 1, 2	Green	} Standard T568A (Standard A)
Pin 3, 6	Orange	

• LAN DTE

End device
Router

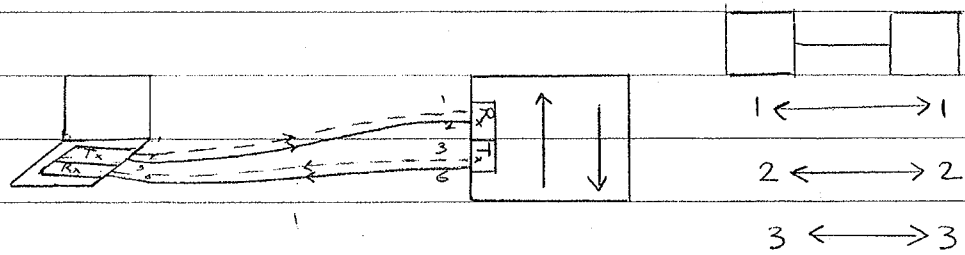
Pin 1, 2	Tx
Pin 3, 6	Rx

LAN DCE

Hub
Switch

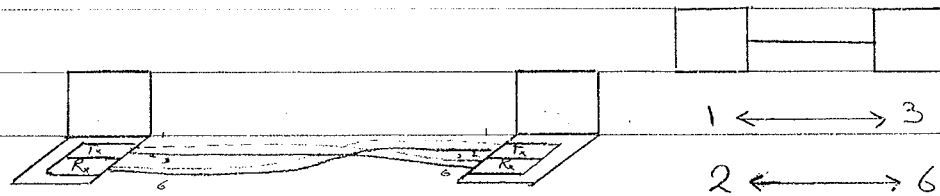
Pin 1, 2	Rx
Pin 3, 6	Tx

1- Straight Cable:

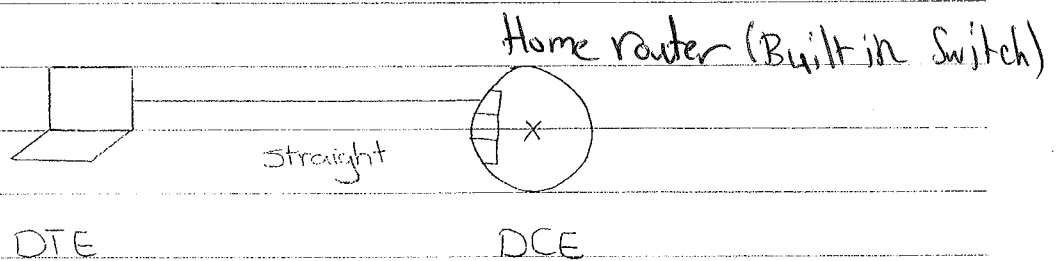


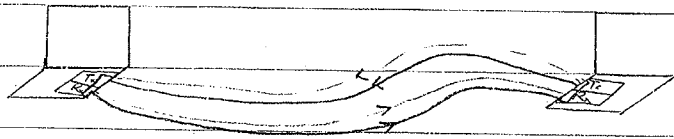
Connect DTE to DCE

2- Cross Cable:



Connect Two DTEs
or: Two DCEs



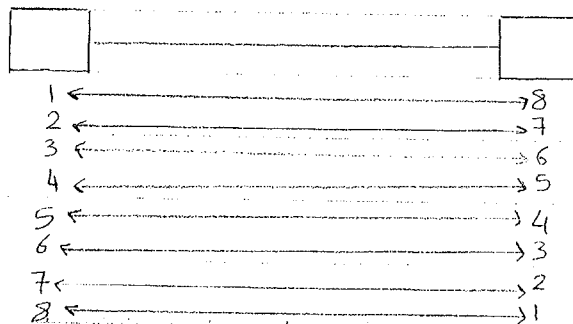
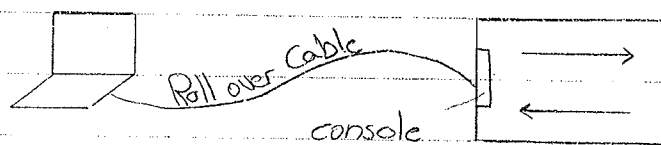


Auto sensing IC:
MDI/MDIX

deh circuit maingoda gowa 1 card, betzabt
1. tawwela law ana mawwsi 3'alat

dis: belbata2 1 system shewaya, fel
sharekat msh matfahaz nestasdm
MDI/MDIX 3shan belbata2
shewaya fel system.

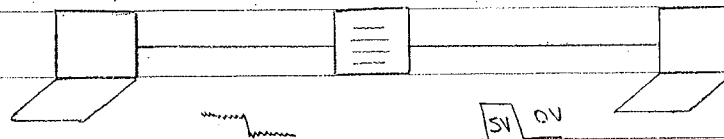
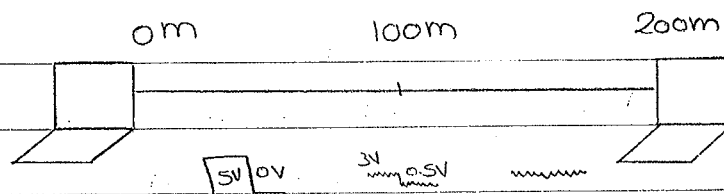
3- Roll over Cable: Configuration Only



4. LAN Physical Layer devices:

1. Repeater:

Regenerates the signal.

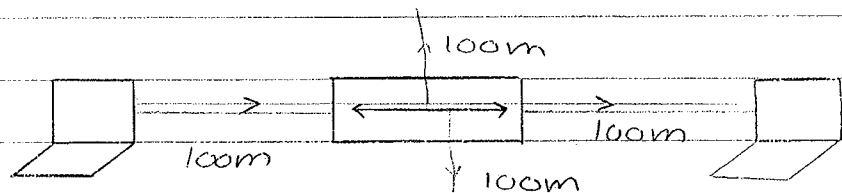


many repeaters add delay (latency)
↓
collision

2. Hub:

It is multi-port repeater. It floods bits. All devices on a hub should work in half duplex. Can either Tx or Rx at same time.

3shan maytsalsh collision or noise mbn b3d, lazam 1 devices teton half-duplex.



* Data Link layer:

MAC address: It is 48-bit physical (H/W) address burnt on ROM of DTE NIC. It is represented in Hexadecimal (0, 1, 2, ..., 9, A, B, C, D, E, F).

Every 4-bit = 1 Hexa.

48-bit = 12 Hexa.

{0AB25C 125ECD} 12 Hexa
IEEE

* Outlines:

• Data link layer:

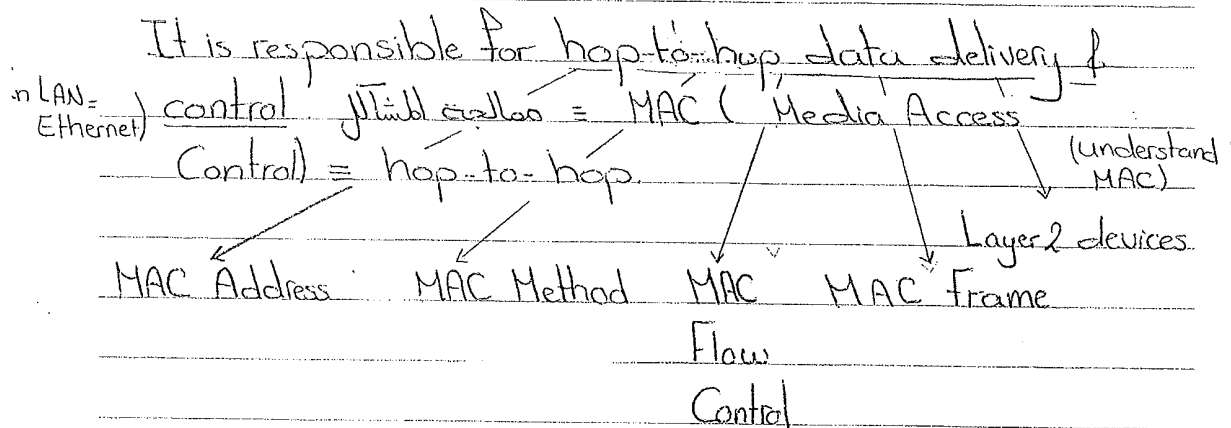
- MAC Address

- MAC Frame

- Layer 2 devices

* Layer 2: Data Link layers

PDU: Frame



* MAC Address:

It is 48-bit address burnt on ROM of DTE NIC. It is represented in Hexadecimal.

(1 Hexa = 4-Bit)

H/W address
physical address

48-bit = 12 Hexa

2780DF 1254EA } 16,777,216
 6 Hexa 6 Hexa 000 000
 FFF FFF

OUI

Host Part (any DTE)

(Organization Unique ID "Vendor Part")

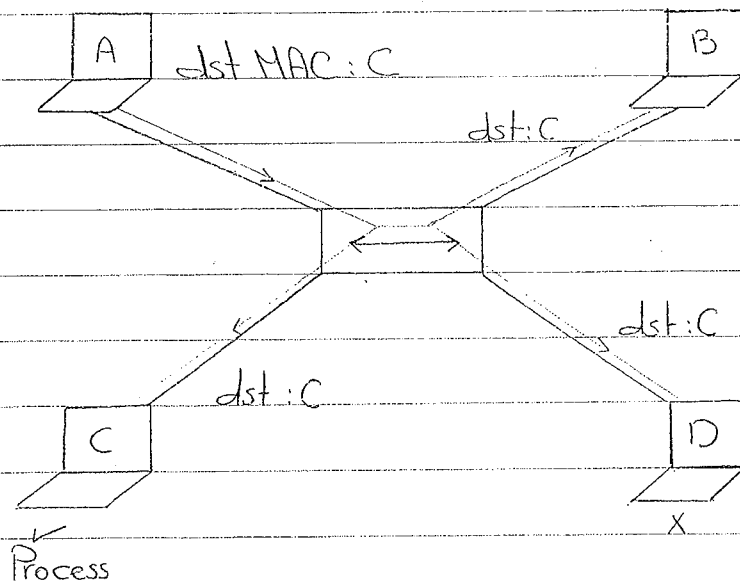
• Hub & Switch are treated as transparent in the network (I switch by their MAC address)
 bs malash MAC address)

Types of destination MAC:

1- Unicast:

One send & only one process

HTTP, FTP, SMTP, POP3



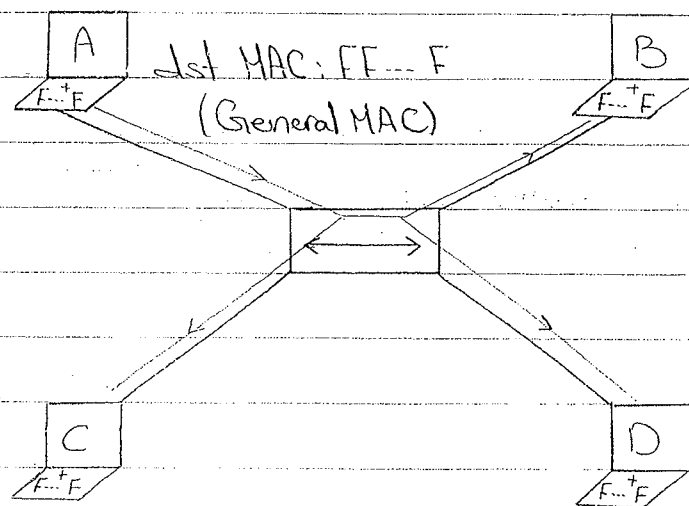
• Hub by 3mi Floo di jahal sig-4
 process

2- Broadcast:

One send to all process.

ARP, DHCP

ARP adalah protocol awal mawasi / gear bel router aw switch bebrat kol / IP's w MAC's elly mawgoda bel network. w / protocol elah gawa / network cards.

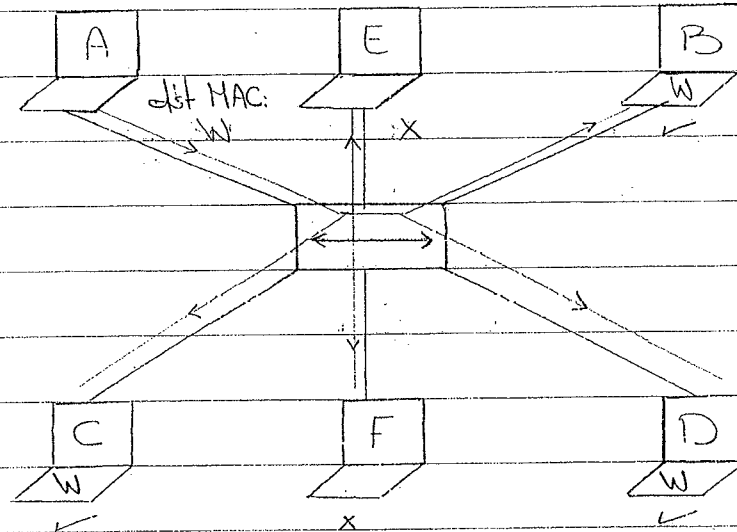


General MAC burnt on maza / unique MAC on ROM.

Broadcast: process ابحار...

3. Multicast:

One send & group process.



3shan 2asba3al media masta3mlsh
hub, switch bs.

01005e xxxxxx
k k

OUI of
multicast

*MAC Frame:

\$ 3

+ \$ 15

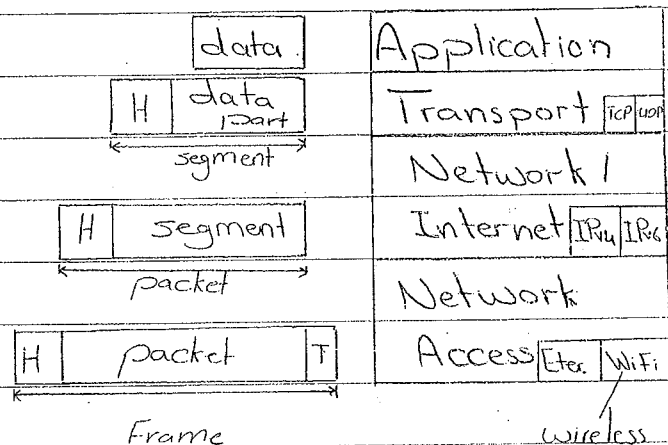
Hawaii

\$ 18

Digital, Intel & Xerox

IEEE 8023 (Ethernet)

TCP/IP



64-bit

48-bit

48-bit

8-byte

6-byte

6-byte

2-byte

46-byte-1500-byte

4-byte

Pre-amble	dst MAC	src MAC	Type	packet	CRC
-----------	---------	---------	------	--------	-----

Training bits

unicast

Type of

Frame check

10101010....

broadcast

next

protocol
(el. packet)

multicast

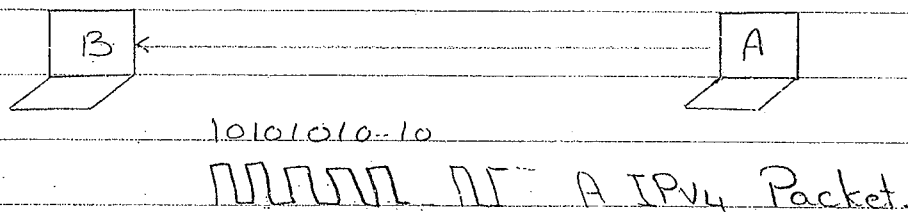
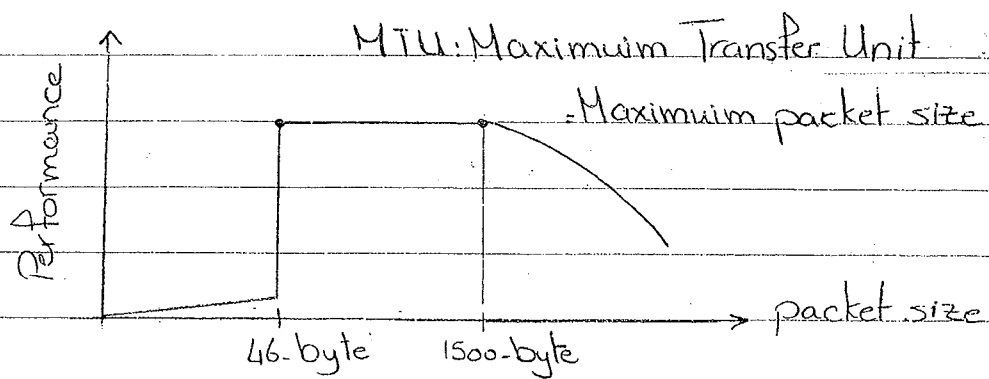
IPv4, IPv6:

auto clocking

protocol:

synchronization
(sig. null byte)

IP, Apple Talk



Frame size:

pre-amble bits msh | kol | data, deh beyb2a
bs | awal data part (awal frame)

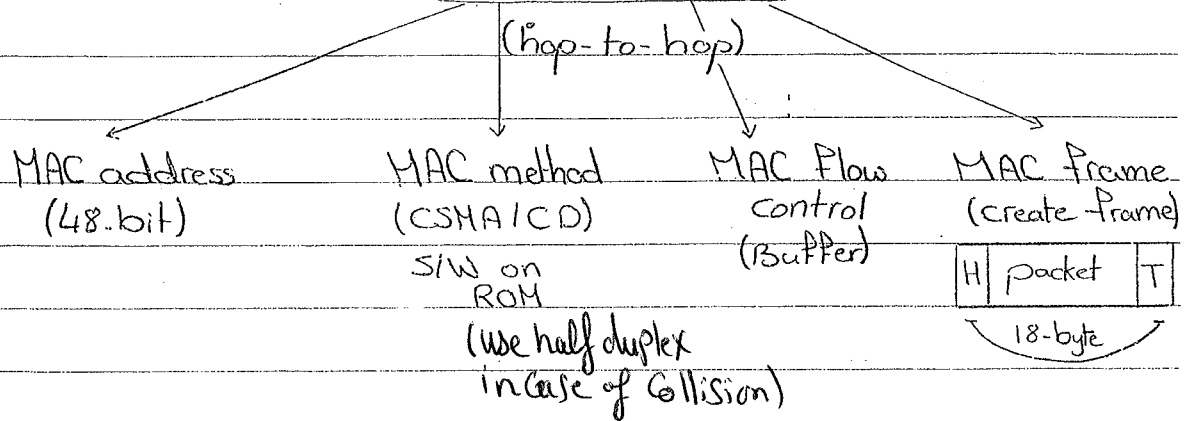
$$\text{maximum: } \overset{14}{H} + \overset{4}{T} + \overset{46}{\text{Packet}} = 64\text{-byte}$$

$$\text{minimum: } \overset{14}{H} + \overset{4}{T} + \overset{1500}{\text{Packet}} = 1518\text{-byte}$$

card / network byrayat mbrn frame w
frame tany, fa wait mbrnrm esmo
idle time.

* Layer 2 Devices:

It is a device that understands MAC



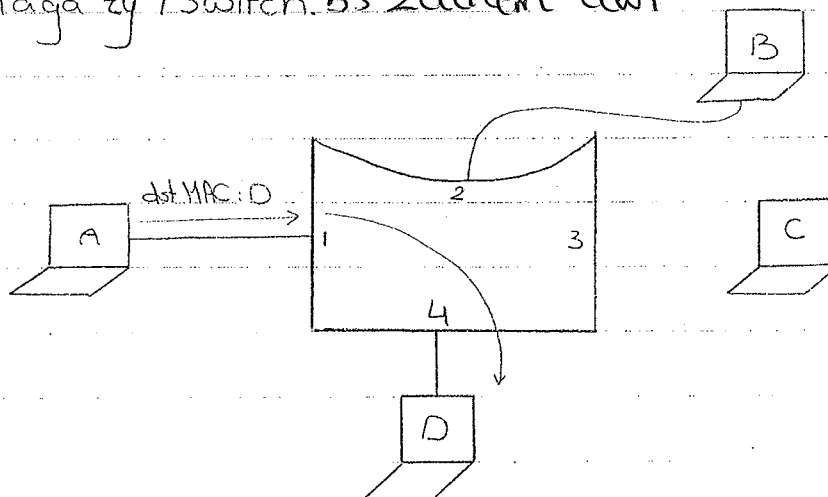
• NIC (Network Interface Card): L1 & L2

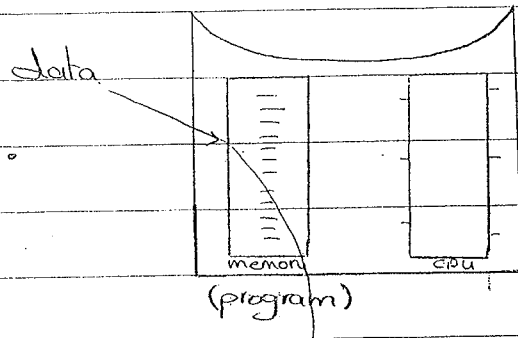
It have MAC

• data component.

• Bridge:

• Faq a zy / switch bs 2adeem awi





S/W based (slow device)

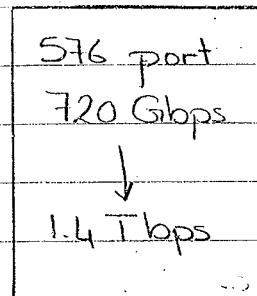
Maximum no. of ports = 16-ports

• 3 and 16-ports 3-shan howa based on programming, ya'ni ana 3 and 16-ports data data 1 memory hot 3-shan 3 and 1 program te 3-shan koto, 16-ports koto howa koto 2.

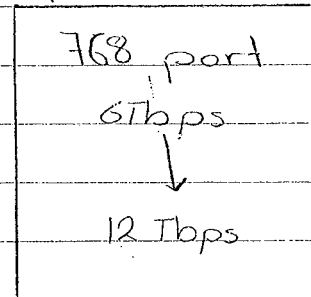
Switch:

It is multi-port bridge.

Cisco Catalyst 6513

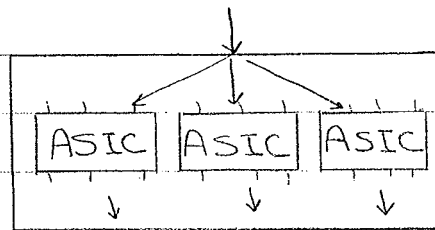


Juniper EX-8216



It is HW based using ASIC.

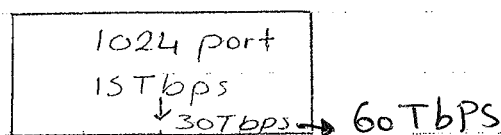
Application Specific Integrated
Circuits



It's speed is wire speed.

kol IC w leha function

Cisco Nexus



* Switch operation:

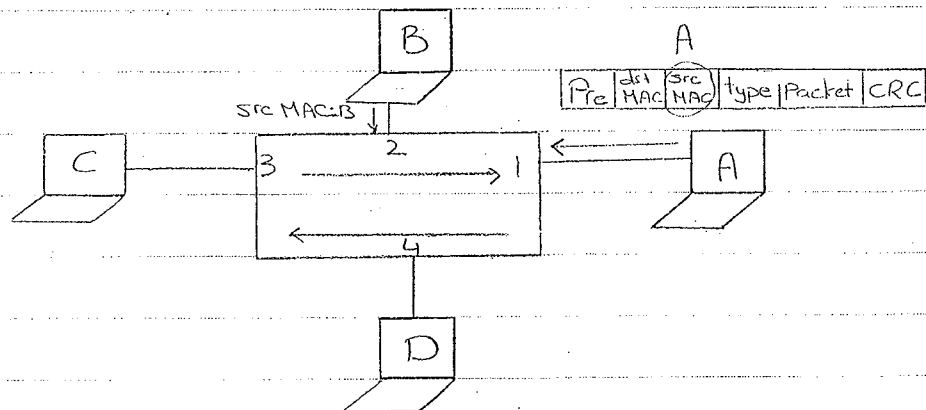
- Learning ASIC → check src MAC
- Forwarding ASIC → check dst MAC
- Remove layer 2 loops

(In LAN)

• switch tech IC II learning and forwarding

* Learning:

Forming MAC address table by checking source MAC in an incoming frames.

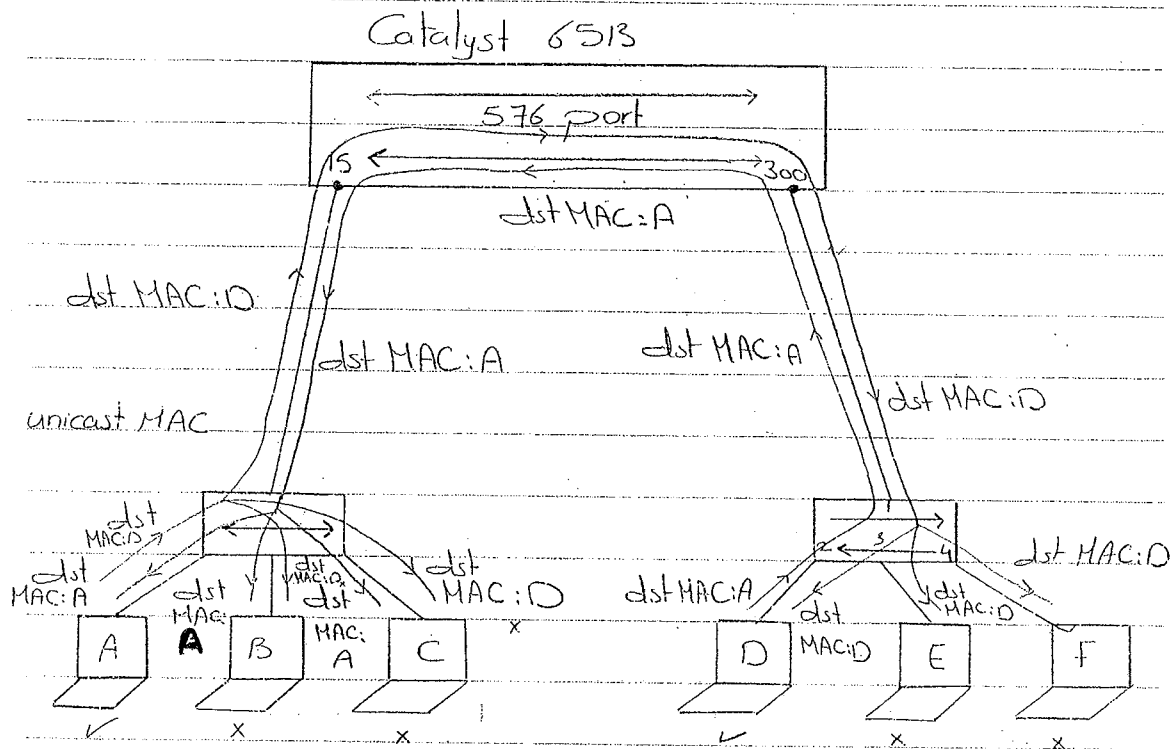


• switch matches MAC address, by forming MAC address.

MAC Table (RAM)

MAC	Port
A	1
B	2

Note: switch will flush inactive entries after 5 minutes by default.



MAC Table

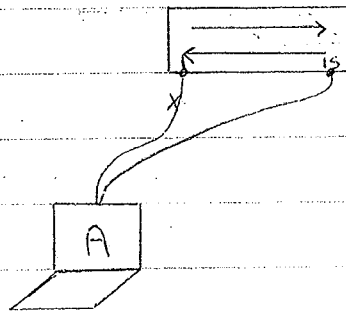
MAC	Port
A	15
B	15
C	15
D	300
E	300
F	300

MAC Table

MAC	Port
D	2
E	3
F	4
A	1
B	1
C	1

- 1 hub malhosh gadwal 3shan msh byf hm 1 MAC address w m3ndesh ASIC, kol switch lech gadwalo...

Note: switch can learn many devices on same switch port.

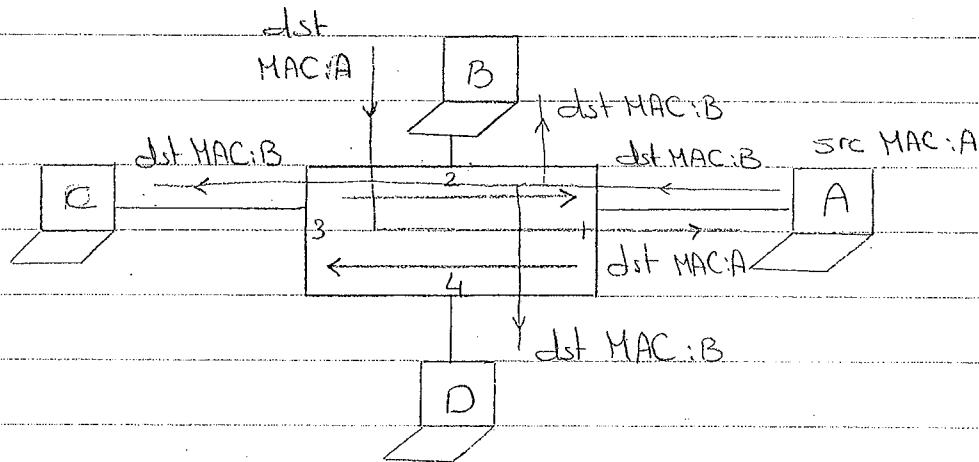


	MAC	Port
	A	1
last update	A	15

Note: switch can never learn same device on different ports.

* Forwarding:

Switching frames to next hop by checking
dst MAC in frames



MAC	Port
A	1
B	2

• law fe port msh active l switch bymsofo, f
law ana 3ayza ab3at ll. port deh l switch
hay-flood l data 3shan howa mas7ha
mn l memory 3ando, w b3d mal port deh
tastlm l data deeh, l qhaz hayb3t
acknowledgement fa l switch hay3raf
l qhaz dah metwasal 3 anhy port.

IF the dst MAC unknown (not in table): the switch will Flood

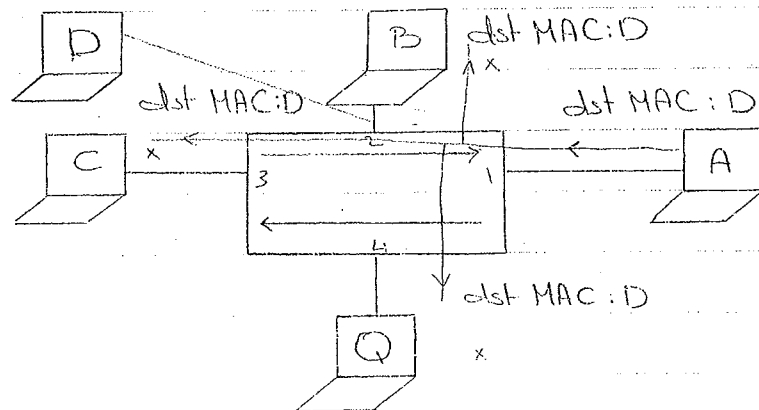
wait b's. elly hay-process.

IF dst MAC multicast: the switch will Flood.

magmo3a by elly hay-process.

IF dst MAC broadcast: the switch will Flood

kolo hay-process.



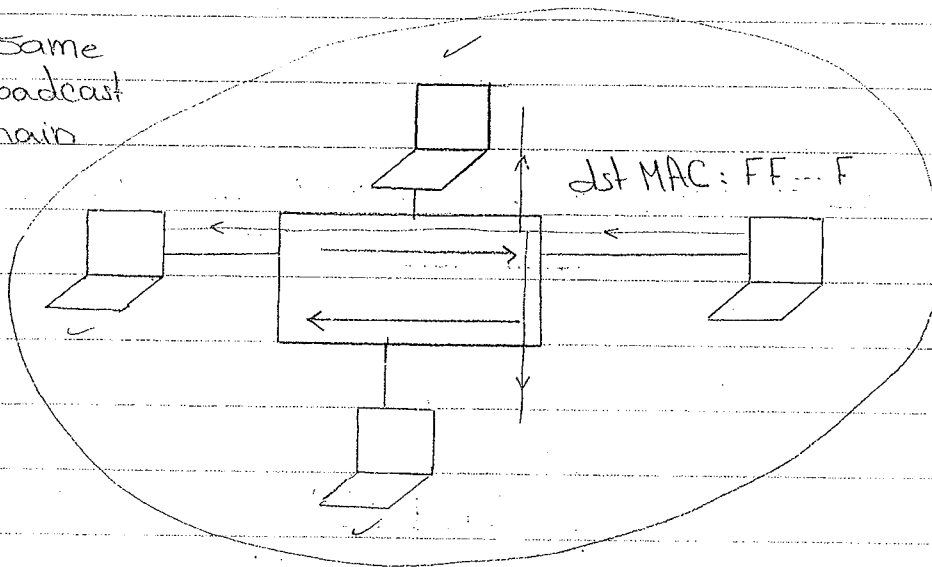
MAC	Port
A	1
B	2
C	3
D	2

emta / switch hayflood: BUM

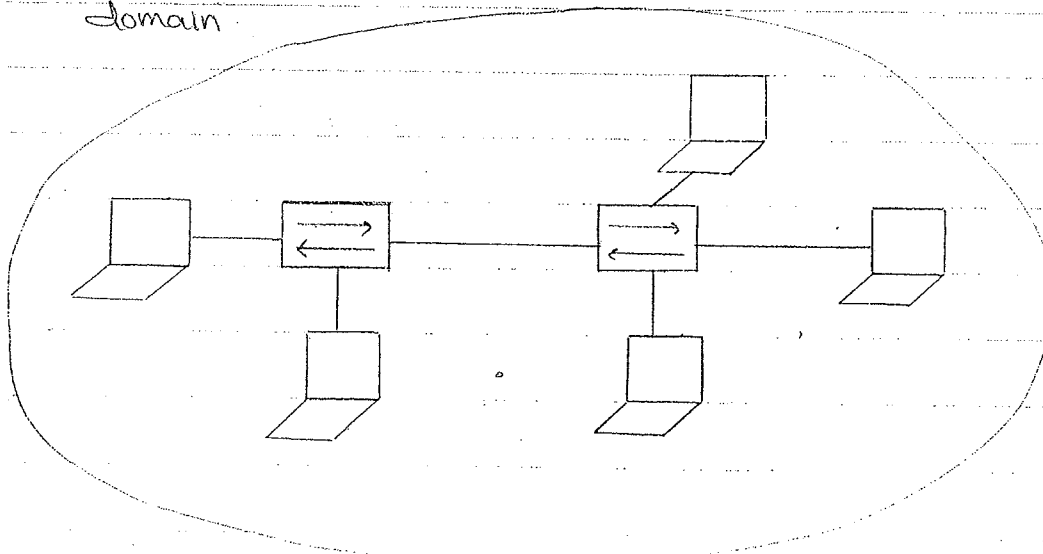
Broadcast Unknown Multicast

Note: all devices on a switch are in the same broadcast domain.

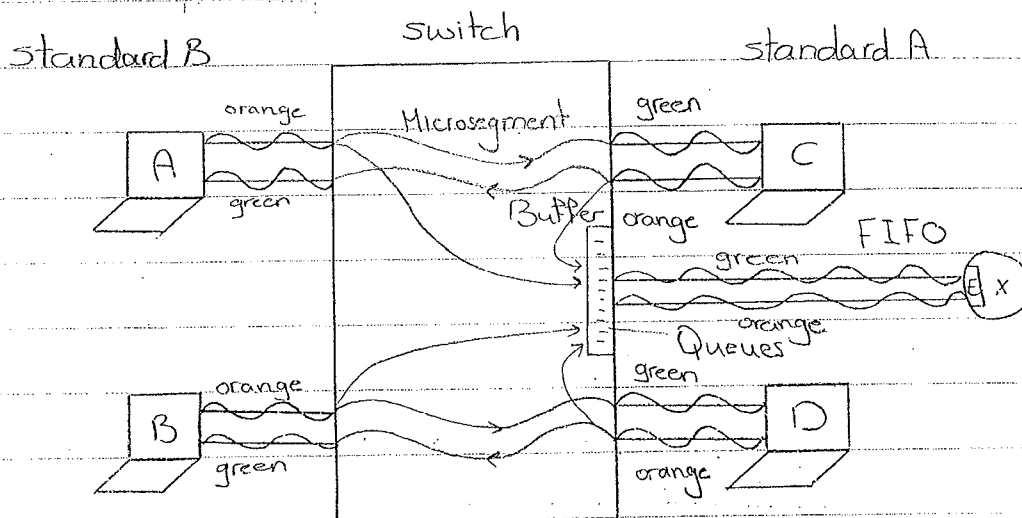
same
broadcast
domain



same broadcast
domain



Forwarding is done using Microsegmentation.



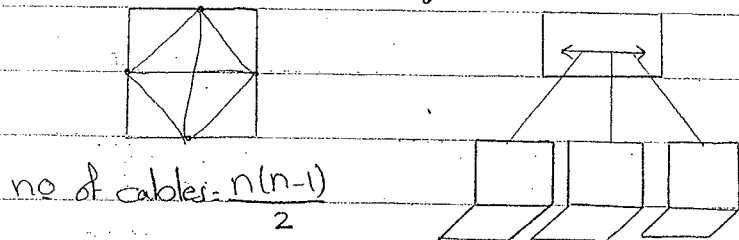
• Feeh buffer gowa / switch (RAM gowa / switch).

• 1 buffer dah by 3mel queues (tabor) ishan law kol 1 agheza 3ayza to 5rog // WAN, bs mBh collision Feeh bs congestion. 1 agheza be 5rog 3ala 7asab heya bazalha ad oh mestaneya fel taboor (FIFO: **First In First Out**)

Note: all devices on switch operate in full duplex. Can both Tx & Rx at same time.

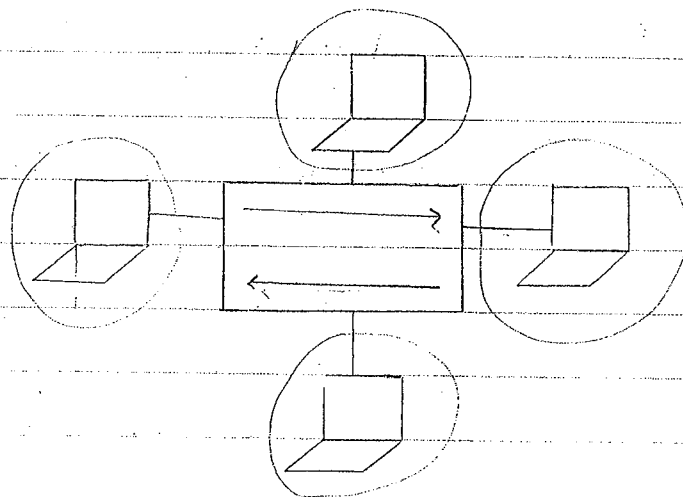
No collision: microsegmentation & buffering.

3rd task (microsegmentation) = $\frac{n(n-1)}{2} \times 2$



Note: all devices on switch are in separate collision domains.

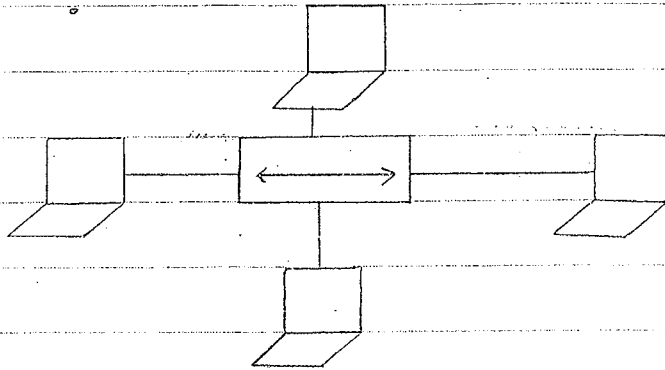
↓
no collision



same broadcast domain
separate collision domain

All devices on all hub same collision domain

↓
ans



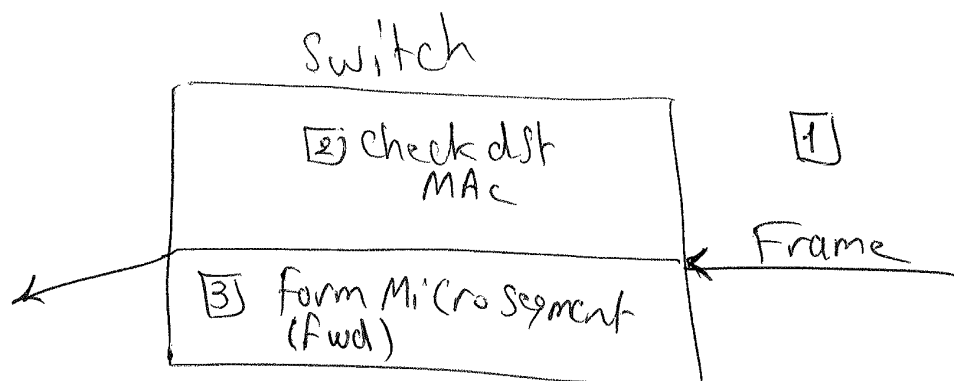
same collision domain

same broadcast domain

Switching modes: (forwarding methods)

1. Cut through: شقّ كبريّا

Wait 14 byte (8 byte Preamble + 6 byte dst MAC)
then Fwd (open Micro Segment)



2- Store & Forward: تخزين و توجيه

wait full frame then fwd.

check all errors

H	packet	T
---	--------	---

< 64-byte

> 1518-byte

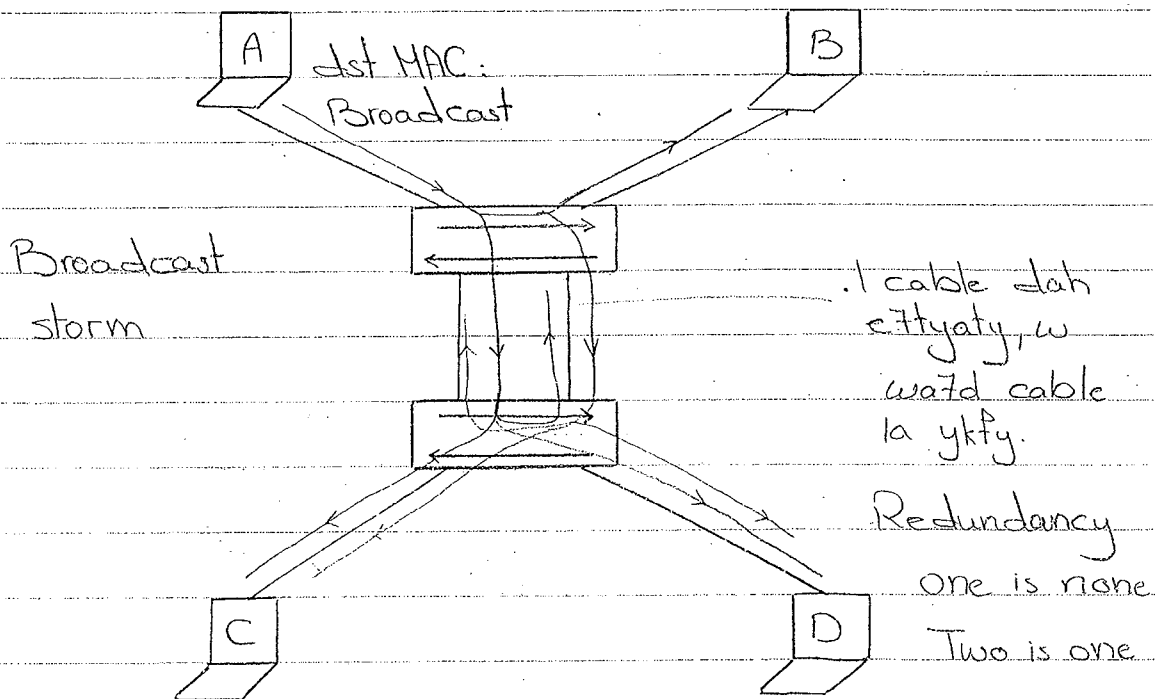
CRC

3- Adaptive-cut through: By Cisco

Mix cut through & store & fwd.

* Switch operation:

- Learning → check src MAC (IC)
- Forward → check dst MAC (IC) (BUM)
- Remove L2 loops → using STP (Spanning Tree Protocol) (Protocol S/W)



: hena haytsi loop (ya3ni 1 data kol shewaya bettbezat
 11. agheza) 3shan ana mewasala mbr 1 two
 switches 2 cables, f ana hastasdm 1 STP
 protocol aw 2a5aly 1 cable 1 tany ehtyaty.

*L3: Internet layer / Network layer:

PDU: "Packet"

It is responsible for end-to-end data delivery.

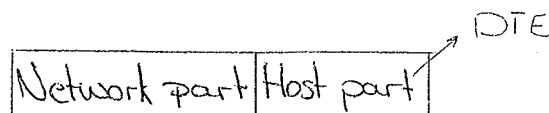
1- Logical addressing

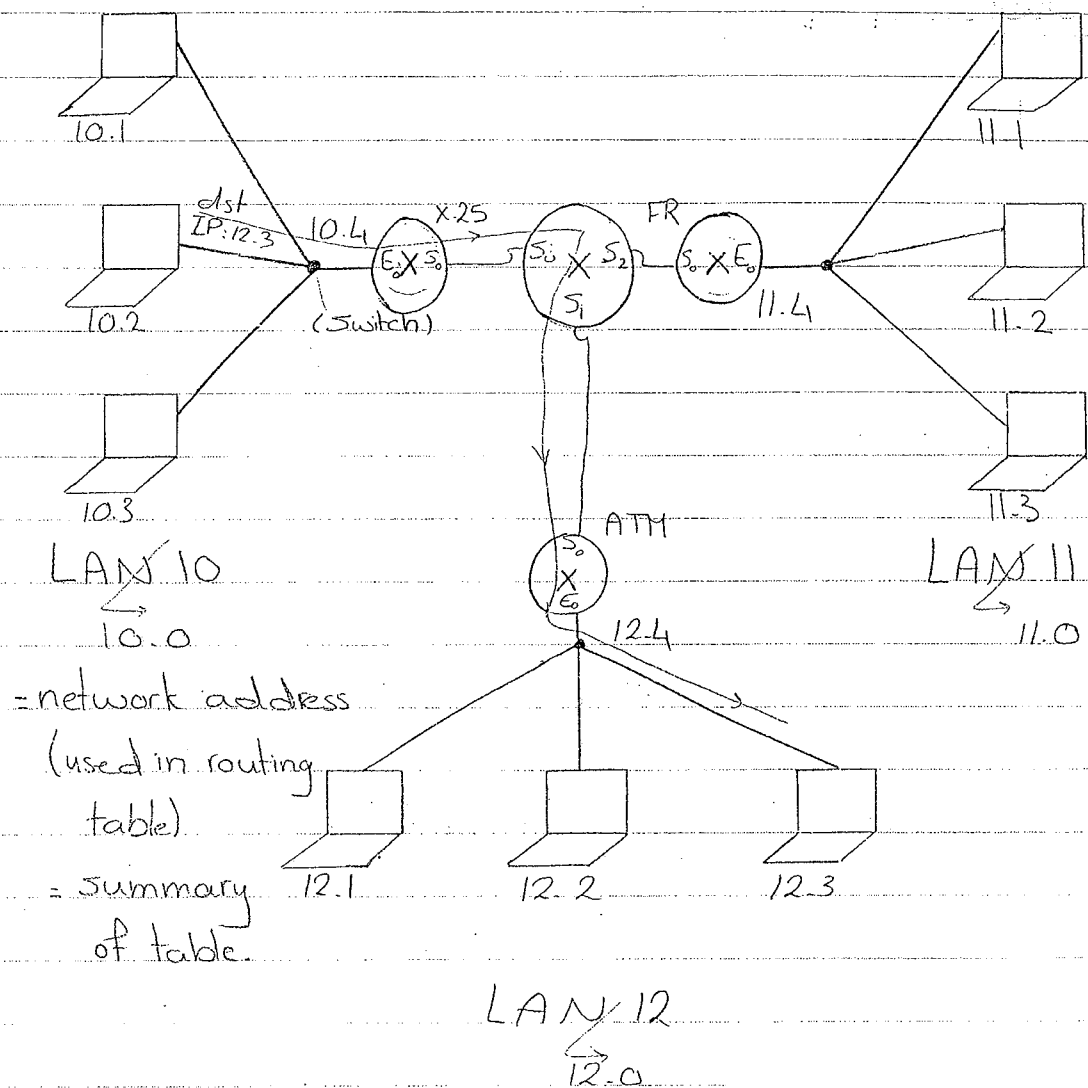
It is SW address giving by configuration used to send data end-to-end.

ex: IP_v4 , IP_v6 , Apple Talk, IP_x
TCP/IP Not for internet access

logical address 3 bits 1 H/W address

IANA (Internet Assigned Number Authority)





router by 3ajar 1 technology.

Routing Table

Network	Interface
10.0	S ₀
11.0	S ₁
12.0	S ₂

• Switching operation: *معالجة البيانات*

Learning: forming MAC table through src MAC

Forwarding: compare dst MAC to MAC table.

known
fwd

unknown
flood

broadcast
flood

• Router operation:

Learning: forming routing table using Routing Protocols

RIP
OSPF

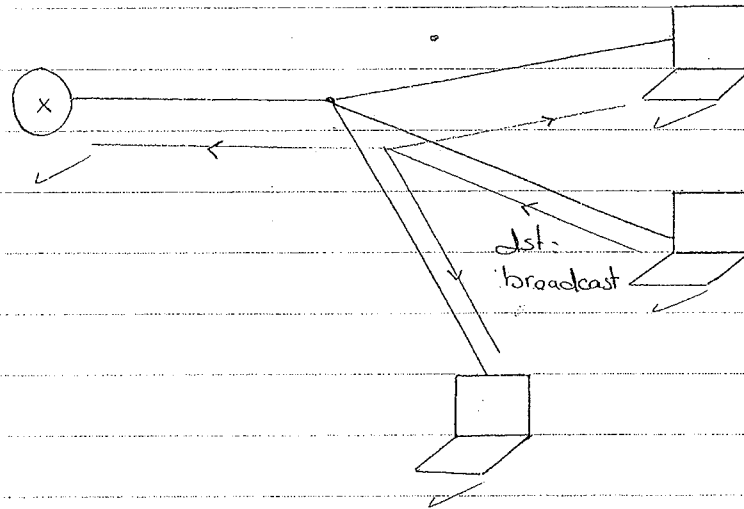
Forwarding: compare dst IP to routing table

known
fwd

unknown
drop

broadcast
process

- 1 broadcast mesh bytla3: bara 1 router (one broadcast domain)



2. Routing:

finding best path to final end using Routing Protocol

Note:

L2 Technology	L2 address
Ethernet	MAC (48-bit)
Wi-Fi	MAC (48-bit)
X.25	X.25 number (8-bit)
FR	DLCI (10-bit)
ATM/DSL	VPI/VCI (16-bit)

DLCI: Data Link Circuit ID.

VPI/VCI: Virtual Path ID/Virtual Circuit ID.

*Outlines:

• IPv4.

• IPv4 shortage.

• Subnetting.

* IPv4: Internet Protocol $\equiv$ end-to-end protocol.

↓
Internet layer: L3

It is responsible for: logical addressing $\equiv$ IPv4 address,
encapsulating data end-to-end $\equiv$ IPv4 header.

• IPv4 address:

4, xxx, xxx, xxx IPv4

It is 32-bit address. It is represented in dotted decimal.

1010 1010 . 1111 1111 . 0000 0000 . 0000 1111
170 . 255 . 0 . 15
← octet →

Class A:

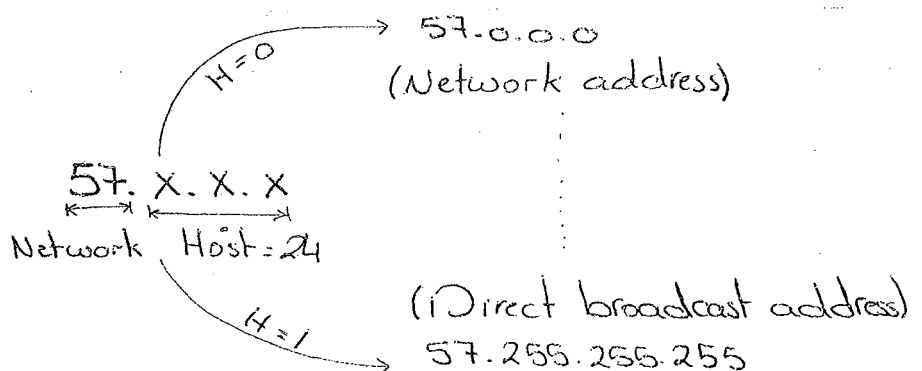
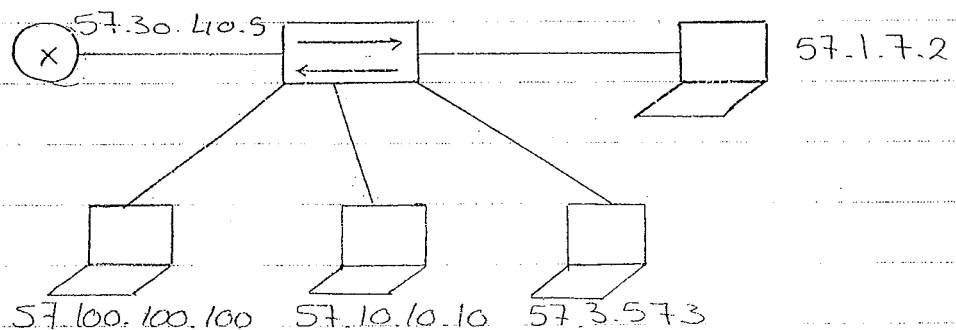
First octet : 1 - 126

Network	Host	Host	Host
---------	------	------	------

$H = 24\text{-bit}$

$$2^{24} = 16,777,216$$

ex.:

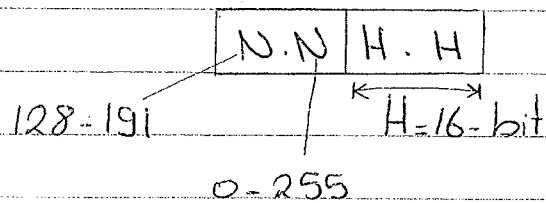


$$\text{No. of IPs} = 2^H = 2^{24} = 16,777,216 \text{ IP}$$

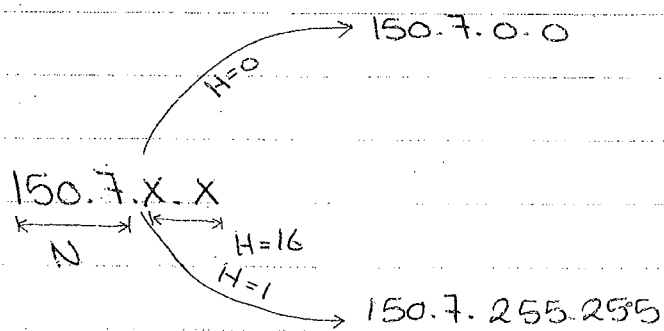
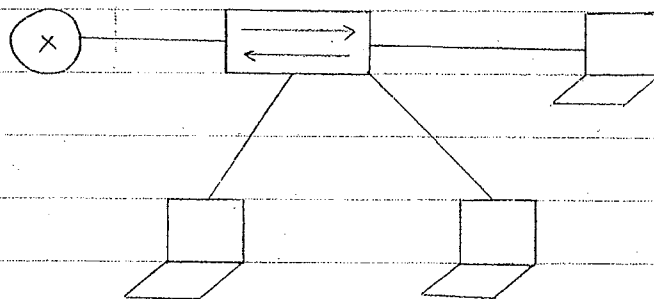
$$\text{No. of hosts} = 2^H - 2 = 2^{24} - 2 = 16,777,214 \text{ host.}$$

Class B:

First octet: 128 - 191



ex.:

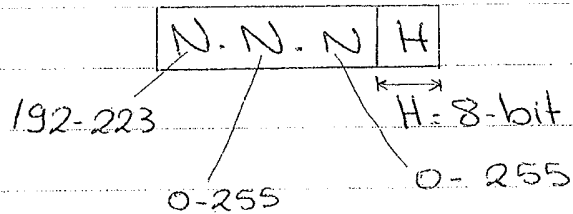


$$\text{No. of IPs} = 2^H = 2^{16} = 65,536 \text{ IP}$$

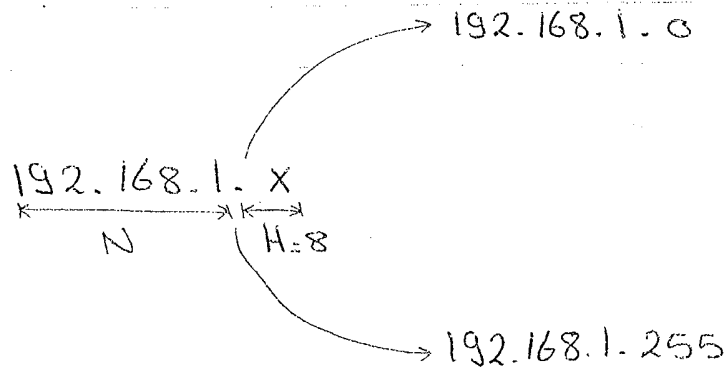
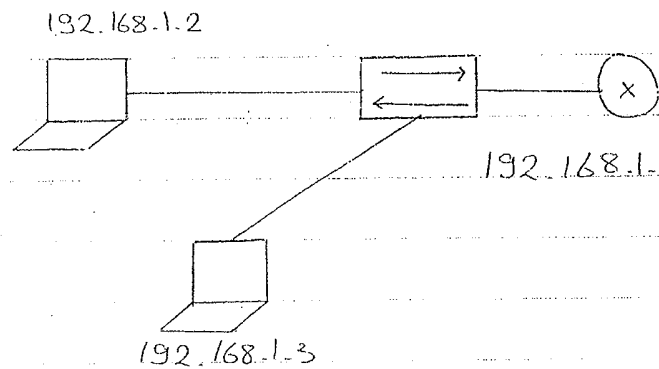
$$\text{No. of hosts} = 2^H - 2 = 2^{16} - 2 = 65,534 \text{ host}$$

Class C:

first octet: 192 - 223



ex.:



No. of IP = $2^H = 2^8 = 256$ IP.

No. of hosts = $2^H - 2 = 2^8 - 2 = 254$ host.

*IPv4 Classes:

Class A: N . H . H . H
 $\xleftrightarrow{N}$ $\xleftrightarrow{H=24\text{-bit}}$

First octet: 1 - 126

No. of IPs: $2^H = 2^{24} = 16,777,216$ IP

Class B: N . N . H . H
 $\xleftrightarrow{N}$ $\xleftrightarrow{H=16\text{-bit}}$

First octet: 128 - 191

No. of IPs: $2^H = 2^{16} = 65,536$ IP

Class C: N . N . N . H
 $\xleftrightarrow{N}$ $\xleftrightarrow{H=8\text{-bit}}$

First octet: 192 - 223

No. of IPs: $2^H = 2^8 = 256$ IP

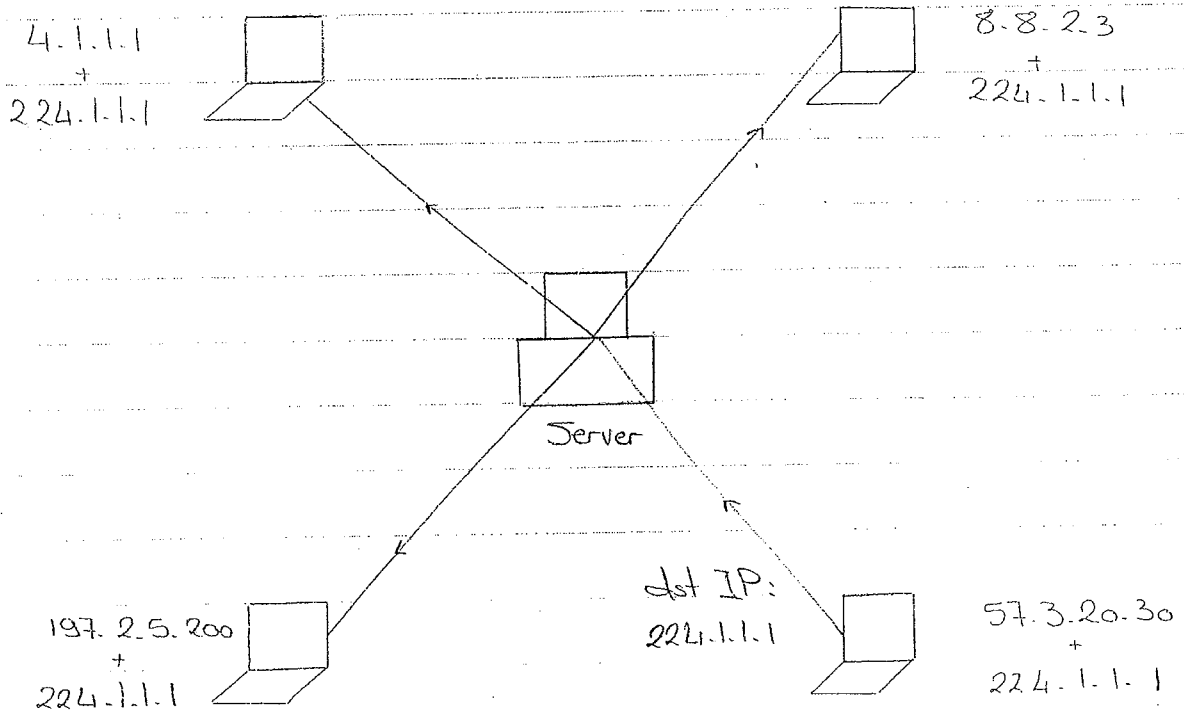
Unique IP (unicast IP)

Class D: used for multicast.

First octet: 224 - 239

224. x . x . x

239. x . x . x

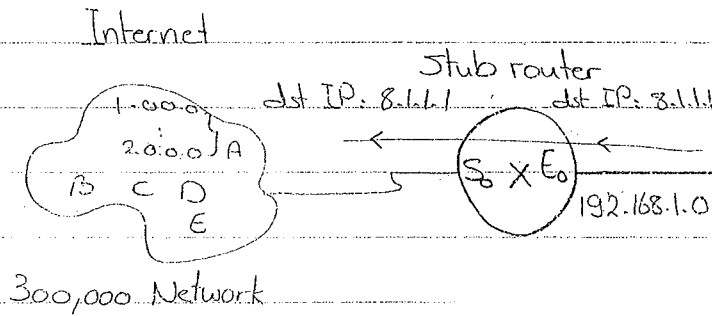


Class E : used for researches & military applications.

First octet : 240-254

• Classless IP :

0 : 0.0.0.0 All IPv4 networks



Routing table

Network	Inter-Face
192.168.1.0	E ₀
0.0.0.0	S ₀

سكة التي ماولش سكة

last resort

أخر ماولان

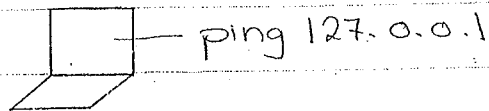
127 : 127.0.0.1 Used for S/W test

↓
Used for loopback test.

↓
internal S/W

↓
Test TCP/IP protocols stack

↓
layers



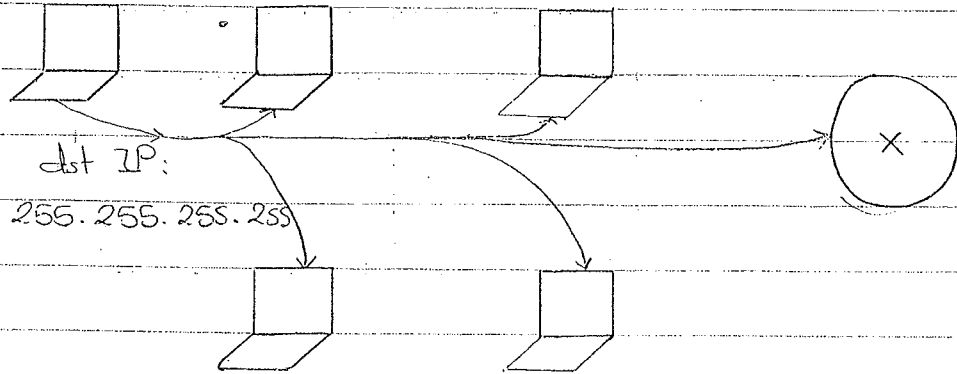
feh program esma CMD fel computer bey-test

! TCP/IP w hawa kyrod b:

success → TCP/IP sha'sal

Failure → TCP/IP msh sha'sal

255: 255.255.255.255 All IPv4 devices



bytal hena broadcast ya3ni kol l agheza hatsta2bl
bs elly metwasalen fe nts l LAN bs
la2n l router msh haytala3 l broadcast bara
l LAN, la2n kol l agheza deh metwasal feh
nts l port fcl router

Local Broadcast (non routable)

↓
inside LAN only

57. 255.255.255 = Direct broadcast
(can be used on WAN) (routable)

* IPv4 shortage:

$$2^{32} = 4,xxx,xxx,xxx \text{ IP}$$

for Example

Network needs	Class	Wasted IP
6 IP	C (256 IP)	256 IP
536 IP	B (65,536 IP)	65,1000 IP
300,000 IP	A (16,777,216 IP)	16,xxx,xxx IP

• IPv4 shortage solutions:

1- IPv5 = 64-bit (researches only)

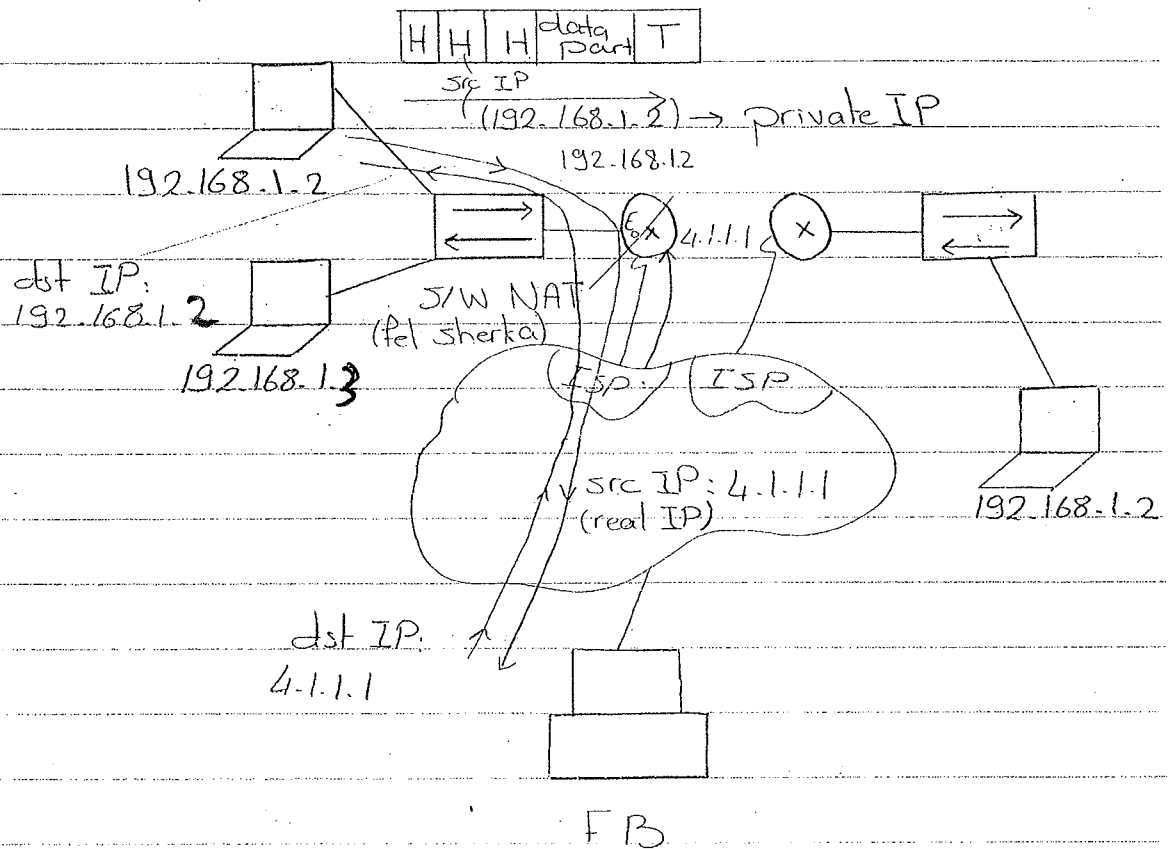
IPv6 = 128-bit

$$2^{128} = 3.4 \times 10^{38} \text{ IPv6} \approx 5 \times 10^{28} \text{ IPv6/human}$$

2- Subnetting.

discussed later

3- Private IP + NAT (Network Address Translation)



ISP: Internet Service Provider.

1 ISP bydy real IP badl 1 private IP 3shan
1 private IP mynf3sh atla3 beh 3ala 1 net.

Private IP: Free IPs $\rightarrow$ Used for private LAN & private WAN

Class A: 10.x.x.x (1-Network)
Class B: 172.16.x.x - 172.31.x.x (16-Network)
Class C: 192.168.0.x - 192.168.255.x (256-Network)

$\Downarrow$

Public IP (real IP) (unique IP)

another Private IPs that will be

discussed later is APIPA

(Automatic Private IP Address)

169.254.x.x

(non routable)

in LAN only

* Subnetting: subnetworking

It is dividing major network into smaller networks called subnets.

It is borrowing part of host bits & give them network (حَقِّقَ البِتَّاتِ بِحَقِّقَ البِتَّاتِ)

256	IP	} Major network	
65,536	IP		} class A, B, C
16,777,216	IP		

200.7.8.x	256 IP = Major network
-----------	------------------------

200.7.8.0

200.7.8.1	64 IP
-----------	-------

subnet 1

200.7.8.63

200.7.8.64	64 IP
------------	-------

subnet 2

200.7.8.127

200.7.8.128	64 IP
-------------	-------

subnet 3

200.7.8.191

200.7.8.192	64 IP
-------------	-------

subnet 4

200.7.8.255

Subnet mask:

ليجدر عدد الـ IP
في كل Subnet

/32 → 1 IP
/31 → 2 IP
/30 → 4 IP
/29 → 8 IP
/28 → 16 IP
/27 → 32 IP
/26 → 64 IP
/25 → 128 IP
/24 → 256 IP
/23 → 512 IP
⋮
/16 → 65536 IP
⋮
/8 → 16777216 IP
⋮
/2 → 1,048,576 IP
/1 → 2,097,152 IP
/0 → 4,194,304 IP (all IPs)

Rule is
/Mask
⇒ No. of IPs
32-Mask
= 2
= no. of IPs

Rules:

for a given Major network with a mask
if we need to divide it using a

New mask $\Rightarrow$

$$\text{No. of IPs / subnet} = 2^{32 - \text{mask}}$$

$$\text{No. of Subnets} = 2^{\text{new mask} - \text{old mask}}$$

512
 2^9

256	128	64	32	16	8	4	2	1
2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

* IPv4 examples:

ex. 1: For the given major network: 202.77.0/24
we need to divide it using subnet mask 125.

Find:

a- no. of IPs/subnet = 2^H

b- no. of hosts/subnet = $2^H - 2$

c- no. of subnets = 2^{SN}

where SN: diff. bet. new & old mask.

202.77.0/24

No. of IPs = $2^H = 2^8 = 256$ IPs

No. of hosts = $2^H - 2 = 254$ hosts

202.77.0/25 $\rightarrow H=7$

No. of IPs = $2^H = 2^7 = 128$ IPs

No. of hosts = $2^H - 2 = 2^7 - 2 = 126$ hosts

No. of subnets = $2^{25-24} = 2^1 = 2$

202.7.7.0/25

202.7.7.0

202.7.7.1

128 IP

202.7.7.127

202.7.7.128

128 IP

202.7.7.255

• Inside each subnet there are:

1- Network address: IP 0

IP all host bits = 0

Used as entry in Routing Table.

2- Direct broadcast address: IP 1

IP all host bits = 1

Used for protocols & applications.

3- Host address:

IP all host bits $\neq 0$, $\neq 1$.

Used for DTEs.

2^{10} 2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0
 1024 512 256 128 64 32 16 8 4 2 1

H=8

ex. 2: For the given major network: 197.20.30.0/24.

If we will divide it using subnet

mask /27 $\rightarrow H=5$

find:

1- No of IP/subnet

2- No of subnets

197.20.30.0 / 24

No of IPs = $2^H = 2^8 = 256$ IP

No of hosts = $2^H - 2 = 2^8 - 2 = 254$ host

197.20.30.0 / 27

No of IPs = $2^H = 2^5 = 32$ IP

No of hosts = $2^H - 2 = 30$ host

No of subnets = $2^{SN} = 2^3 = 8$

197.20.30.0 /27

197.20.30.0 32 IP

197.20.30.1 subnet 1

197.20.30.31

197.20.30.32 32 IP

subnet 2

197.20.30.63

197.20.30.64 32 IP

subnet 3

197.20.30.95

197.20.30.96 32 IP

subnet 4

197.20.30.127

197.20.30.128 32 IP

subnet 5

197.20.30.159

197.20.30.160 32 IP

subnet 6

197.20.30.191

197.20.30.192 32 IP

subnet 7

197.20.30.223

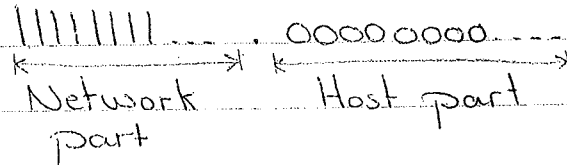
197.20.30.224 32 IP

subnet 8

197.20.30.255

• Subnet mask:

It is 32-bit mask.



ex. 1: IP: 10.7.8.9

mask: 11111111.00000000.00000000.00000000

$$\text{No of IPs} = 2^H = 2^{24} = 16,777,216$$

255.0.0.0

10.7.8.9 255.0.0.0

10.7.8.9 / 8 $\rightarrow H=8$

$\downarrow$
no. of network bits

ex 2: IP: 172.16.6.70

mask: 1111 1111.1111 1111.0000 0000.0000 0000

No of IPs = $2^H = 2^{16} = 65,536$ IP

255.255.0.0

172.16.6.70 / 16 $\rightarrow H=16$

$\downarrow$
no. of network bit

ex3: IP: 192.168.1.1

mask: 1111 1111.1111 1111.1111 1111.0000 0000

255.255.255.0

192.168.1.1 / 24 $\rightarrow H=8$

$\downarrow$
no. of network bit

• 18 , 16 , 24 = default mask

ex. 4: IP: 200.7.8.x

mask: 1111 1111. 1111 1111. 1111 1111. 11 00 0000

255. 255. 255. 192

200.7.8.x / 26 $\rightarrow$ 14=6

No. of IPs: $2^H = 2^6 = 64$ IP

Rule:

if Subnet Mask is given in dotted decimal form. How to get no. of IPs Provided by that mask?

No. IPs = 256 - Mask in dotted decimal form
& multiply the result.

ex: 255.255.255.224

is mask that gives no. of IPs = 256 - mask
= 1.1.1.32 (multiply them)
= 32 IP

ex: if Subnet mask is

255. 255. 252. 0

$$\Rightarrow \text{No. of IPs} = 1. 1. 4. 256 = 1024 \text{ IP}$$

ex: if mask is

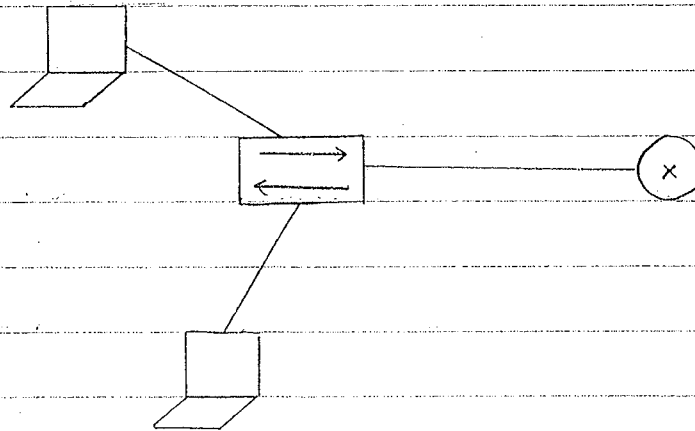
255. 255. 0. 0

$$\begin{aligned} \Rightarrow \text{No. of IPs} &= 1. 1. 256. 256 \\ &= 65536 \text{ IP} \end{aligned}$$

2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1024	512	256	128	64	32	16	8	4	2	1
			1			1	1	1	1	

ex. 3:

197.20.30.137 / 27



Find:

a- 1st IP (Network address).

b- Last IP (Broadcast address).

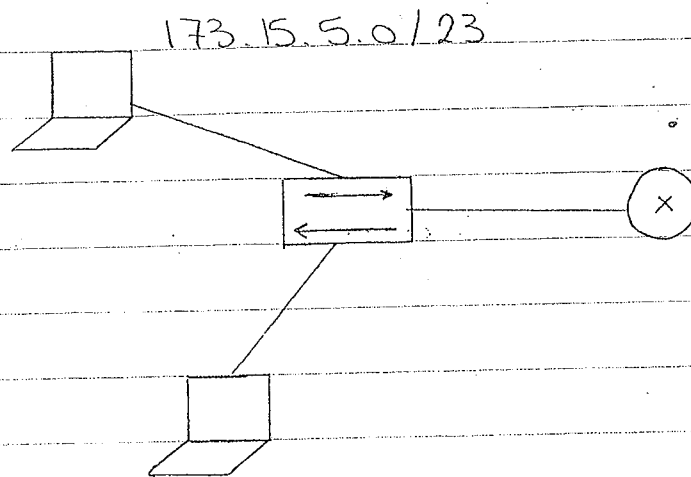
197.20.30.137 / 27 $\rightarrow H=5$

197.20.30.1000 1001
متغير

1st IP 197.20.30.1000 0000
197.20.30.128

Last IP 197.20.30.1001 1111
197.20.30.159

ex. 4:



173.15.5.0/23 ^{H=9}

173.15.0000 0101. 0000 0000

1st IP

173.15.0000 0100. 0000 0000

173.15.4.0

Last IP

173.15.0000 0101. 1111 1111

173.15.5.255

ex. 5: 10.10.10.10 / 10

10.10.10.10 / 10 $\rightarrow H=22$

10.0000 1010.0000 1010.0000 1010

10.0000 0000.0000 0000.0000 0000

10.0.0.0

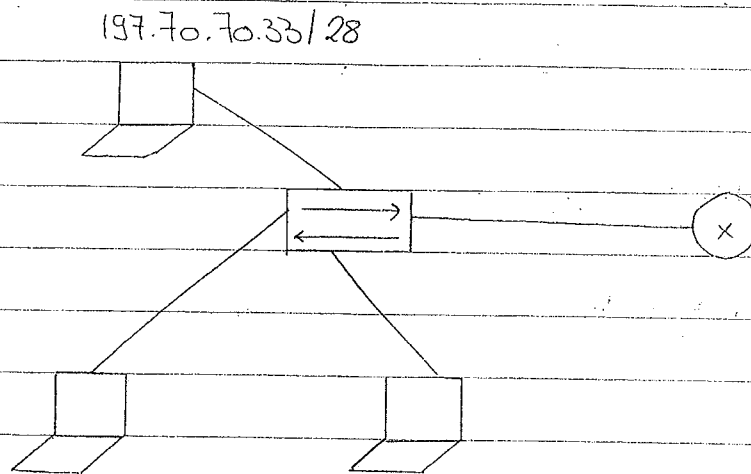
10.0011 1111.1111 1111.1111 1111

10.63. 255. 255

2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
1024	512	256	128	64	32	16	8	4	2	1

*IPV4 example:

ex.: For the given host



Find:

- a- No of IPs in that subnet.
- b- First IP
- c- Last IP
- d- first & last host address.

197.70.70.33/28 $\rightarrow H=4$ class C
 197.70.70.0010 0001

197.70.70.0010 0000 197.70.70.32

197.70.70.0010 1111 197.70.70.47

197.70.70.32

197.70.70.33

197.70.70.46

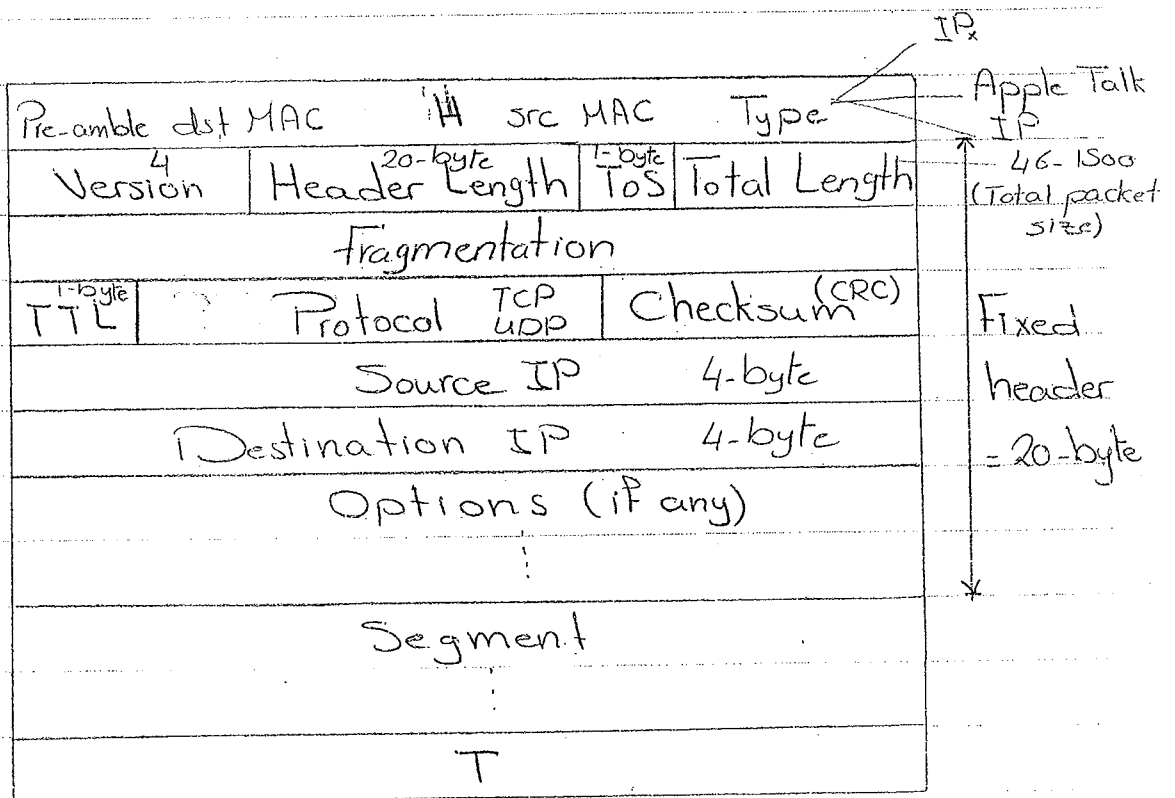
197.70.70.47

No. of IP = $2^4 = 2^4 = 16$ IP

No. of hosts = $2^4 - 2 = 2^4 - 2 = 14$ host.

* IPv4: Internet Protocol
 L3 $\equiv$ end-to-end

It is responsible for: logical address (IPv4 address, end-to-end encapsulation (IPv4 header).

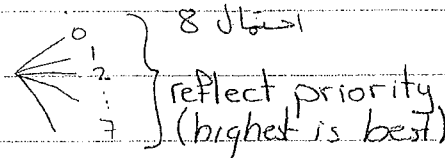


Source IP: 4-byte.

Destination IP: 4-byte.

Version: 4-

TOS (Type of Service):

1-byte used 3 bits  8 bits
reflect priority
(highest is best)

Used for QoS:

Data 0, 1, 2, 3

Video 4

Voice 5

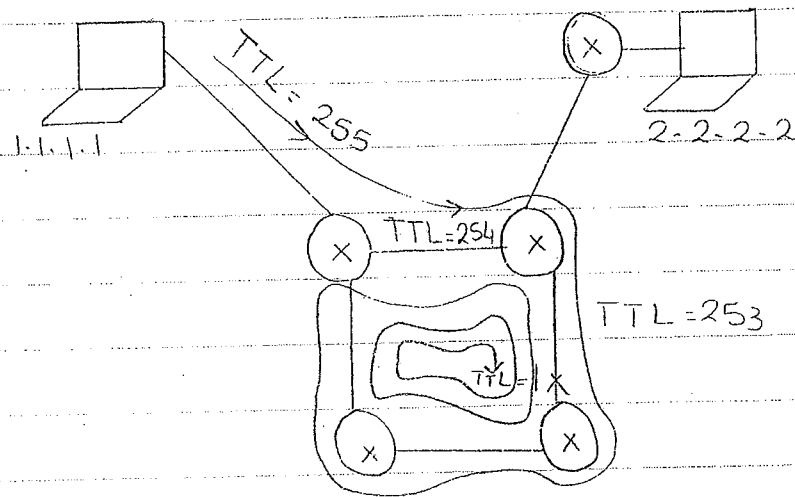
Router protocols 6 (end-to-end)

Switch protocols 7 (hop-to-hop)

TTL (Time To Live):

1-byte = 8-bit $\leftarrow \begin{matrix} 0 \\ 255 \end{matrix}$

To remove L3 loops.



- lama | TTL=1, 1 router byzmelaha drop w haywa2f 1 loop.

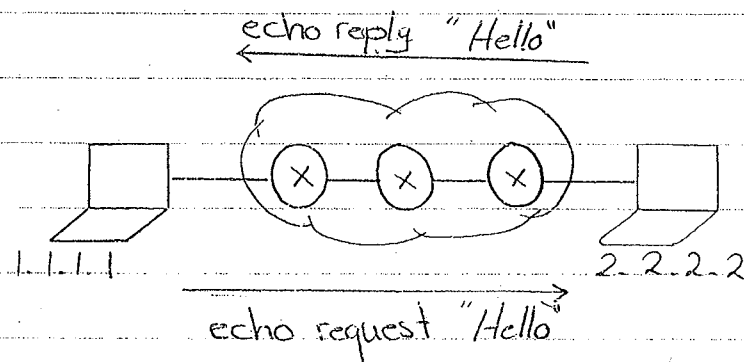
الخطوات لإصلاح الخلل

* Troubleshooting end-to-end data delivery:

Using ICMP (Internet Control Messaging Protocol) L3 = end-to-end

معالجة الخلل (Troubleshooting)

1- Echo request / echo reply msgs:



ping 2.2.2.2
command → Test end-to-end connectivity

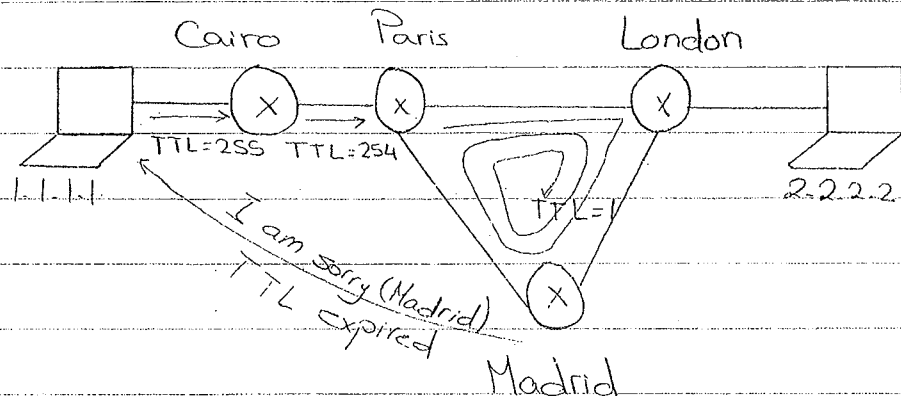
win : 4 - echo

linux : ∞ echo

IOS : 5 - echo

ال ping command هو يعمل على SW في ال TCP/IP
وال ICMP في ال echo request
Test for end-to-end connectivity like echo reply

2. TTL expired:



win ← Tracert 2.2.2.2

linux ← Traceroute 2.2.2.2
IOS

1- Cairo

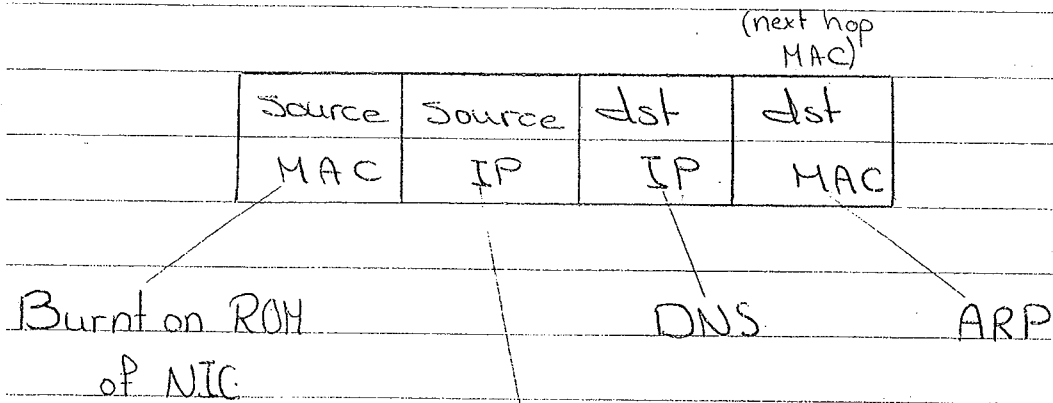
2- Paris

3- London

* * * (3min security)

4- 2.2.2.2 (end)

* Getting started for end-to-end data delivery:



- Manual: (static)

IP

Mask

Default gateway

DNS

- Automatic:

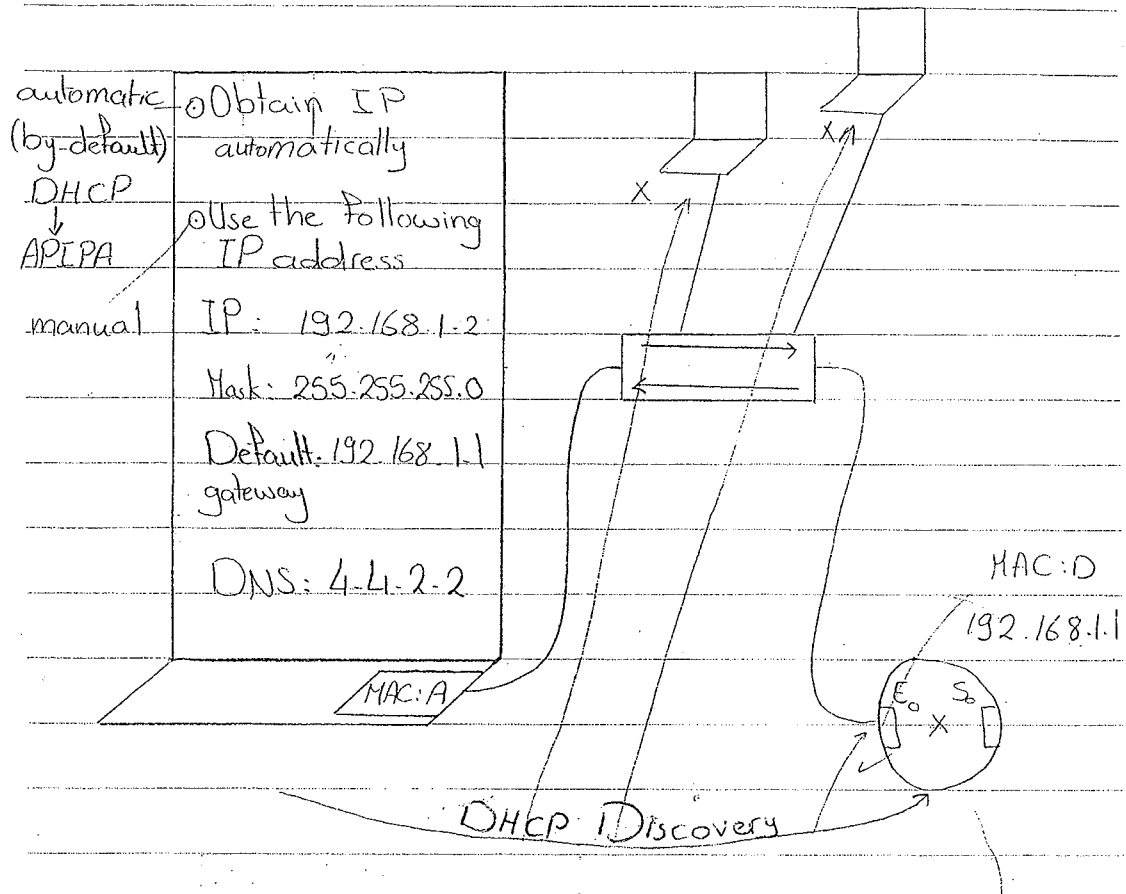
RARP (Reverse ARP)

BootP (Booting Protocol)

DHCP (Dynamic Host Configuration Protocol)

APIPA

DHCP:



src MAC: A	src IP: 0.0.0.0	H	Who is DHCP server?	T
dst MAC: F-F	dst IP: 255.255.255.255	UDP		

Lease time
24 hours

DHCP Offer

IP: 192.168.1.2 Mask: 124
D-g: 192.168.1.1 DNS: 4.4.2.2

DHCP server

DHCP pool

IP: 192.168.1.0
192.168.1.255
Mask: 124
D-g: 192.168.1.1
DNS: 4.4.2.2

DHCP Accept & Request Reservation

DHCP Acknowledgement

- Feh 2-options 3shan 2a5od IP ll gehaz betazy:
Automatically: en ana 2a5od 1 IP by-default

en ana 2a5od IP mn 1

DHCP server w deh betasama
be DHCP. Aw 3n tare2 1

APIPA bs msh haldar

atla3 bech 3ala 1 net,

APIPA: 169.254. x . x /16

(non-routable) in LAN only.

Manually: en ana 2a7ot IP mn 3ala mazagy.

- law 3ndy one server w wa2a3 ha5od IP mn
1 APIPA aw ne7ot 2 DHCPs

- law 1 2 DHCP ractb 3ala 1 computer,
1 computer hay-accept 1 2a2rab offer
First offer is the best offer.

• Tare2et 1 DHCP et3amalt b DOAA
(DORRA)

Note: 3shan ageb 1 IPs mn 1 shakl dah:

255. 255. 255. 248

256-mask = $1 \cdot 1 \cdot 1 \cdot 8 = 1 \times 1 \times 1 \times 8 = 8$ IP.

255. 255. 255. 240

256-mask = $1 \cdot 1 \cdot 1 \cdot 16 = 16$ IP.

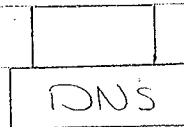
DNS: Domain Name Server
System

Resolve 1st IP

Howa Sabara 3n dalel 11 IP.

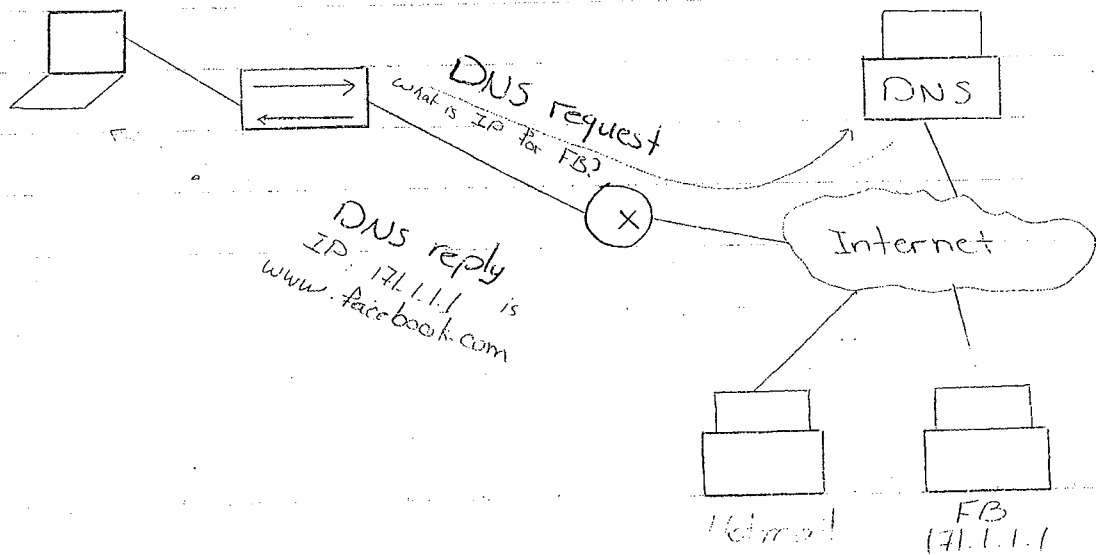
DNS Table

Name	IP
Facebook	171.1.1.1
Hotmail	171.1.1.5
Yahoo	2.2.2.7

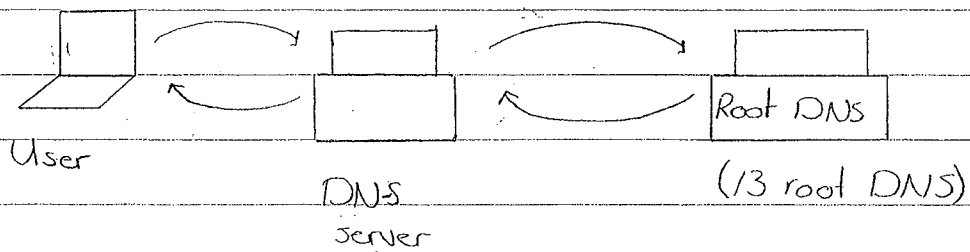


IANA for IP 171.1.1.1
WWW for Facebook

www.facebook.com



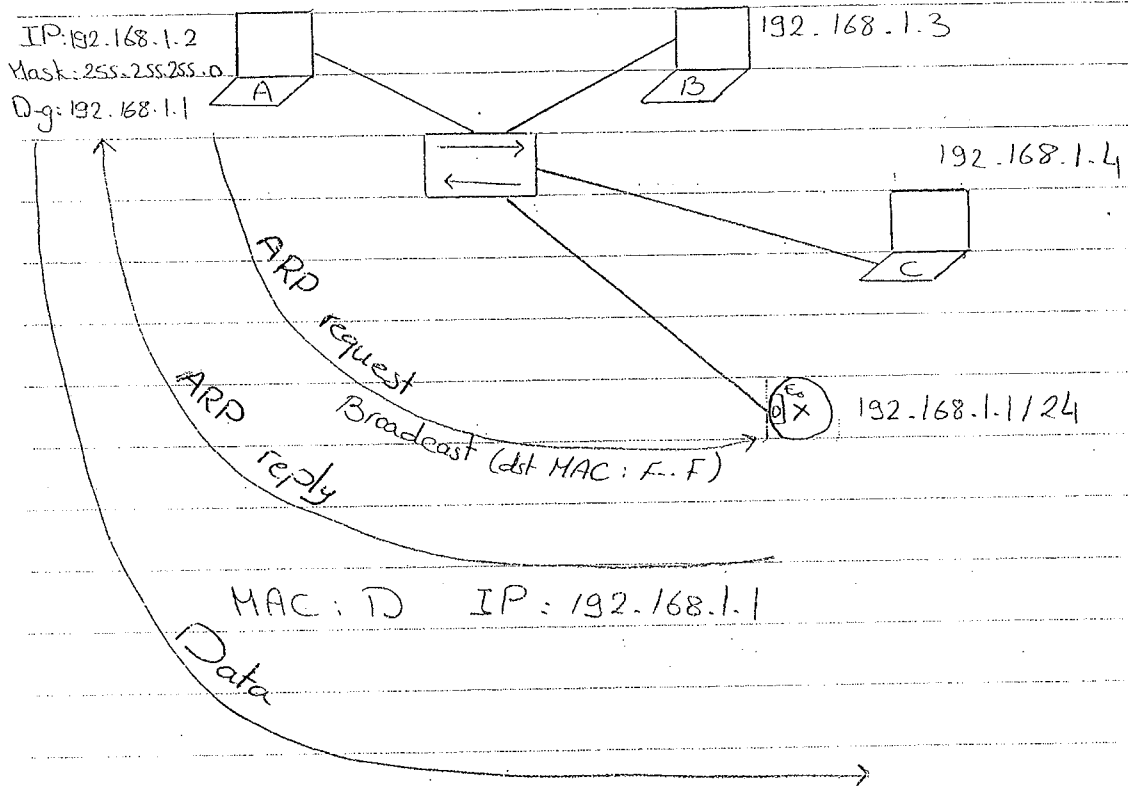
- 1 DNS dah server mawgood fd service provider
aw m̄mkn n̄st5dm 1 DNS betā3 google 3shan
1 DNS betā3 1 service provider m̄mkn yō2a3
f 3shan kda Lafall en n̄st5dm google DNS



law ana 3ayza 2a5osh 3ala site msh masagel
fd DNS server, f 1 DNS server byroot 11
Root DNS.

ARP : Address Resolution Protocol (Layer 2)

Resolve unknown MAC.



20-byte

Src MAC: A	Src IP: 192.168.1.2	H	data part	T
dst MAC: D	dst IP: 192.168.1.1			

ARP Cache

IP	MAC
192.168.1.1	D
192.168.1.3	B
192.168.1.4	C

- Samalna mask 3shan 2a3raf meen fwaleya w
fateru default gateway 3shan 2a3raf any IP
dah ll router.

- Command in CMD : arp -a

- law 3andy data na2sa fel dlt IP or MAC
f. feh session tanya betctfetat.

• All commands are

• To open CMD:

start menu → run → CMD →
properties →

• getmac

• Shows 243raf / MAC address beta3y

• ipconfig

, Private

• yegchly / IP address, subnet mask &
default gateway (/ IP beta3 / router)

• ipconfig / all

• bytably kol / configuration, MAC, IP, IP₄ &
DNS.

• ping 127.0.0.1

• Test TCP / IP model

TTL = 128 win , TTL = 255 linux

• ping 127.0.0.1 -t

• Continue ping

- control + C

- cancel ping

- There is an icon which consist of 2 computers in the toolbar & double click on TCP/IP

OR

- start menuue → control panel → Network and Internet → Network and Sharing Center → Change adapter settings → right click on any icon then properties. → double click on TCP/IP v4:

- haytlaly two options w 2astar mbrnhm:

- 1. Use the following IP address:

IP address: 192.168.1.0

255

03

31

30

Default gateway (IP beta3.1 router):

192.168.1.25

4 Obtain an IP address automatically:

192.254.x.x/16

1 computer has set IP automatically

best5dm 1 APIPA (Automatic

Private IP address), best5dm in Private

in LAN only (non-routable).

* L4: Transport layer:

PDU: "segment"

It is responsible for end-to-end delivery control.
(e.g. Serial cables)

1. Segmentation:

Dividing data into smaller parts

2. Error detection:

Using CRC

3. Session addressing:

Using S/W port no.s (16-bits)

(0 - 65535) applications

0 - 1023

well known ports

used by servers

1024 - 65535

unregistered ports

used by users as session no.

20, 21 → FTP - 25 → SMTP

23 → Telnet - 53 → DNS

22 → SSH - 67, 68 → DHCP

(Secure Shell)

(Encrypted Telnet)

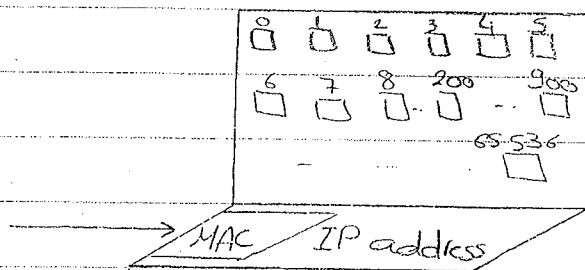
Command in CMD: netstat

To display sessions table:

80 → HTTP

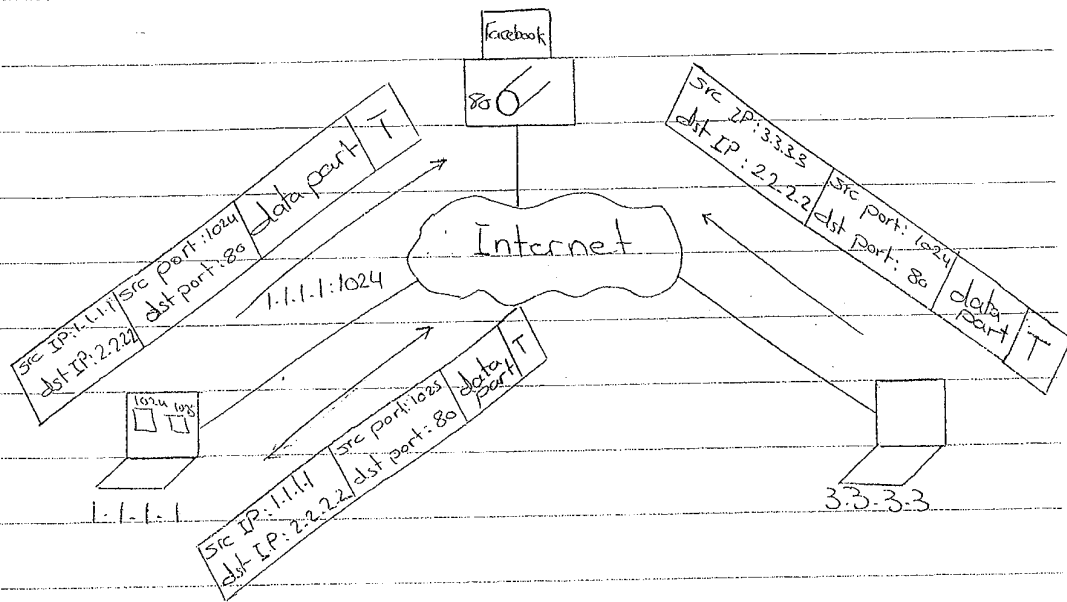
110 → POP3

443 → HTTP (Encrypted HTTP)
secure



kol port bitmasel function mozayana.
aw session mozayana

2.2.2.2



IP: Port

32-bit : 16-bit

Socket no. = Session id

on your end device to display sessions table
Use that Command on cmd:
netstat

* L4: Transport layer:

PDU: "segment"

ex.: TCP (Transmission Control Protocol) (20-byte) إرسال

&

UDP (User Datagram Protocol) (8-byte) إرسال

1. Segmentation

2. Error detection (CRC)

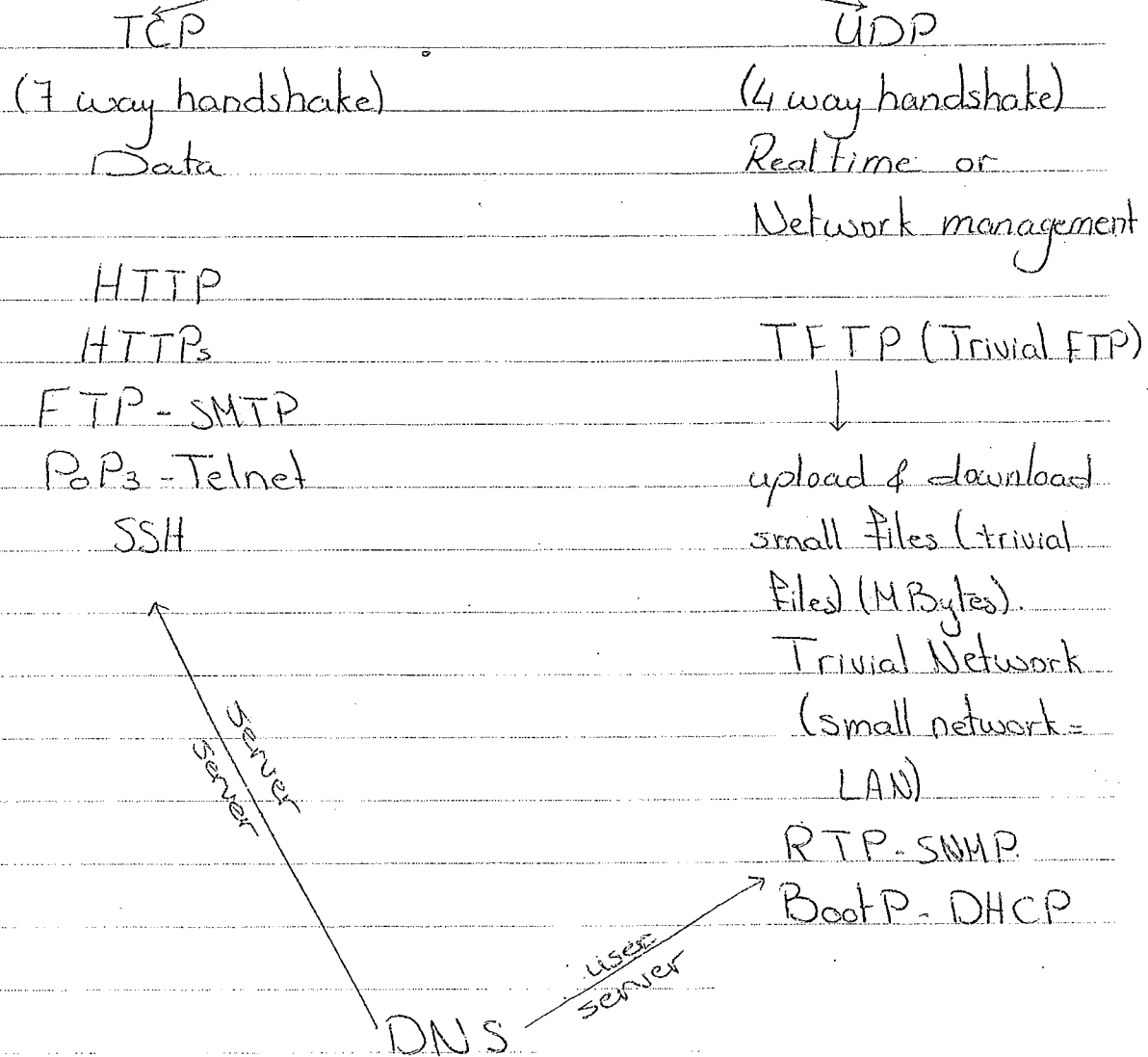
3. Session addressing (src port / dst port)

UDP Header

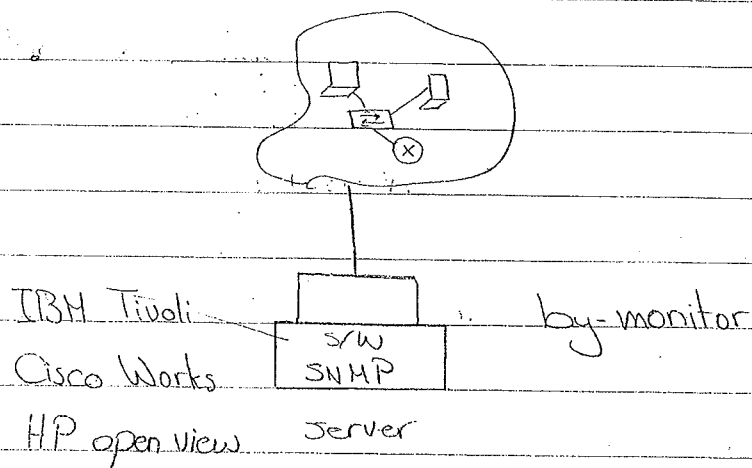
src port	dst port
2-byte	2-byte
Length	CRC
2-byte	2-byte
data part	

segment
length

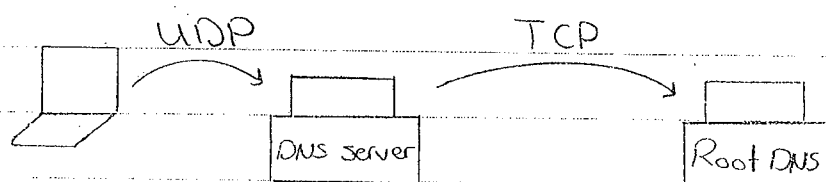
• There are applications use :



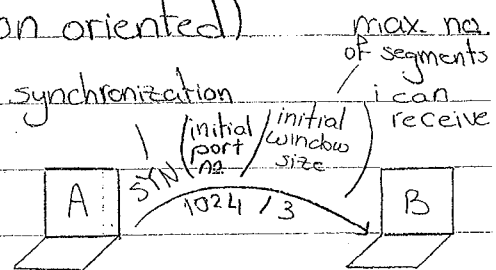
SNMP: Simple Network Management Protocol



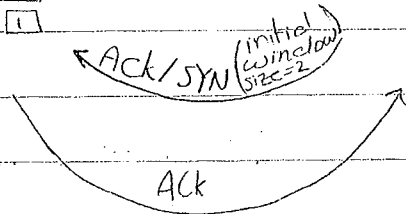
1 protocol dah 2a2dr 2a3rat 1 agheza
elly wasla beya (tafasel 1 shabaka
2a3rat ah 1 agheza 1 active w inactive),
met-setup fel server.



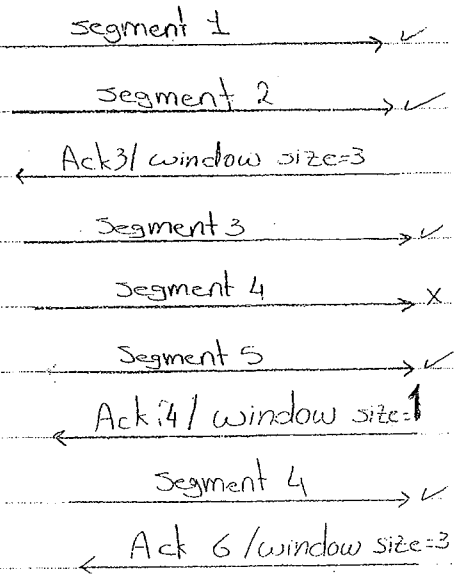
4- For TCP only (Connection oriented)



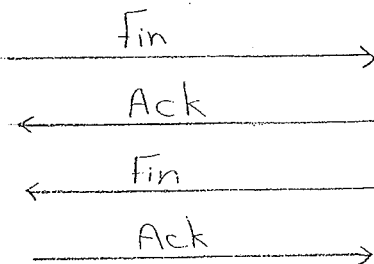
- Session establishment.
(3-way handshake)
- B will not receive more than 2-segments.



- Session management & control.
↓
(windowing)
Flow control



- Session termination
(4-way handshake)



* Routed protocols: is go

HTTP / ^{جاء} SHTTP

It is the protocol that carry user data traffic
end-to-end by supporting:

• end-to-end header.
& . logical address.

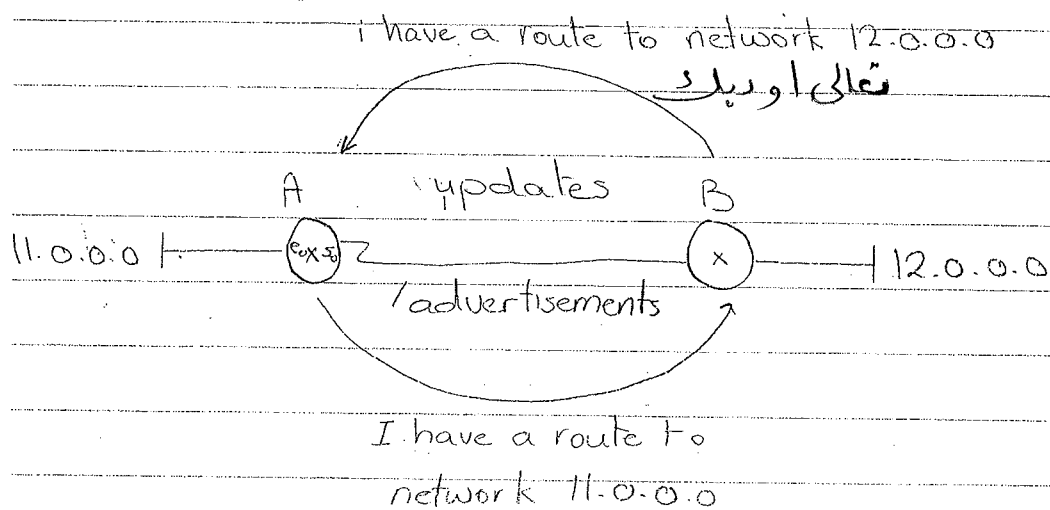
ex.: IPv4, IPv6

IPx, Apple Talk

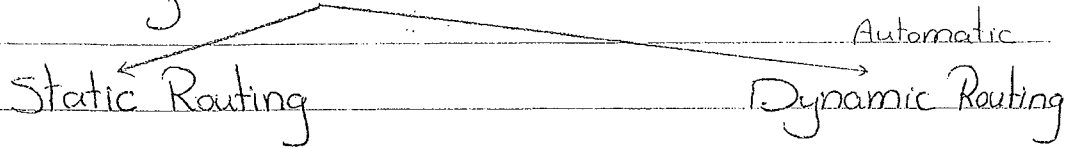
* Routing protocols: ^{قواعد} ~~قواعد~~

It is the exchange of ^{المعلومات} information between routers
so as each router tell others about
networks it can reach.

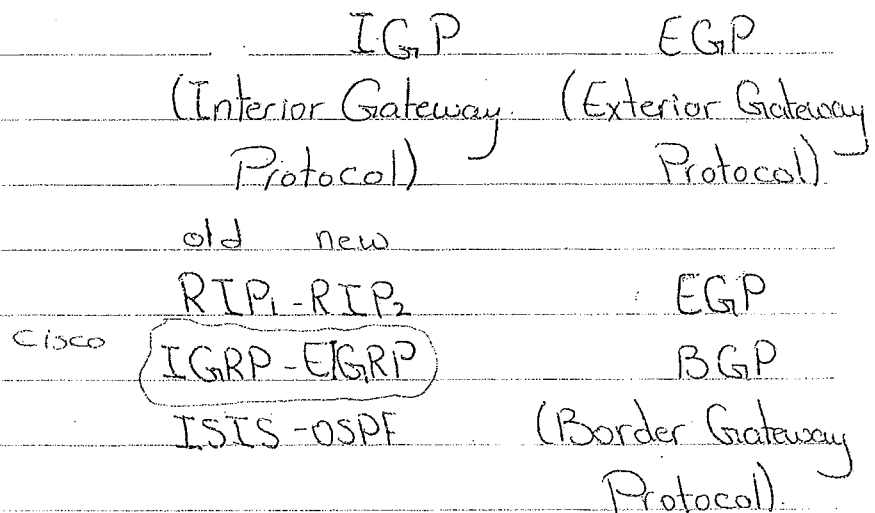
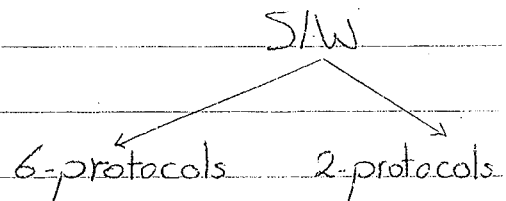
Building Routing Table.



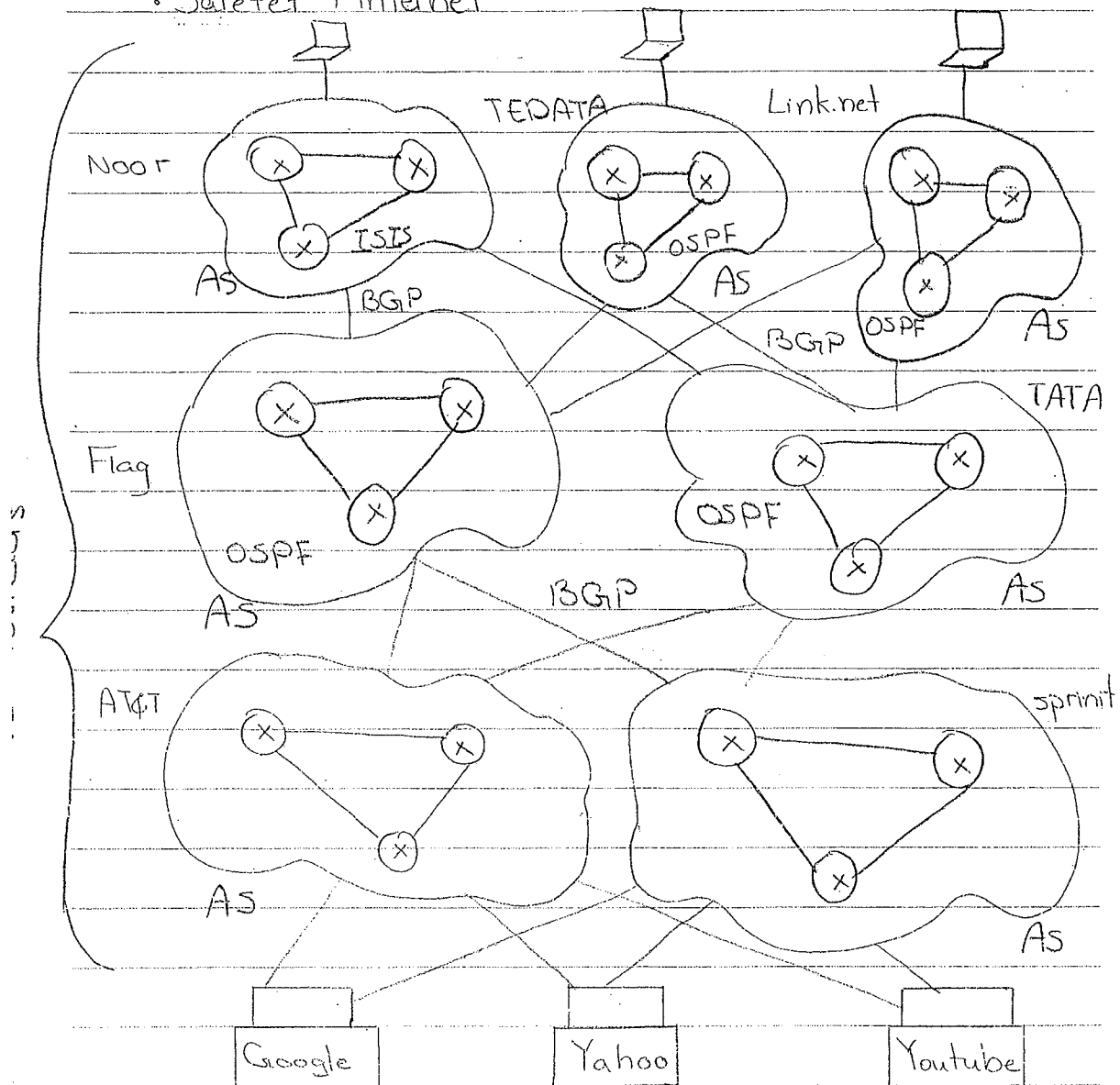
Routing Classification:



Build routing table manually.



• Saretet 1 internet



kol dawla aw service provider lha esm in network : Autonomous System, w bardo

kol dawla w lha number mn 0-65535 (16-bit) mn IANA.